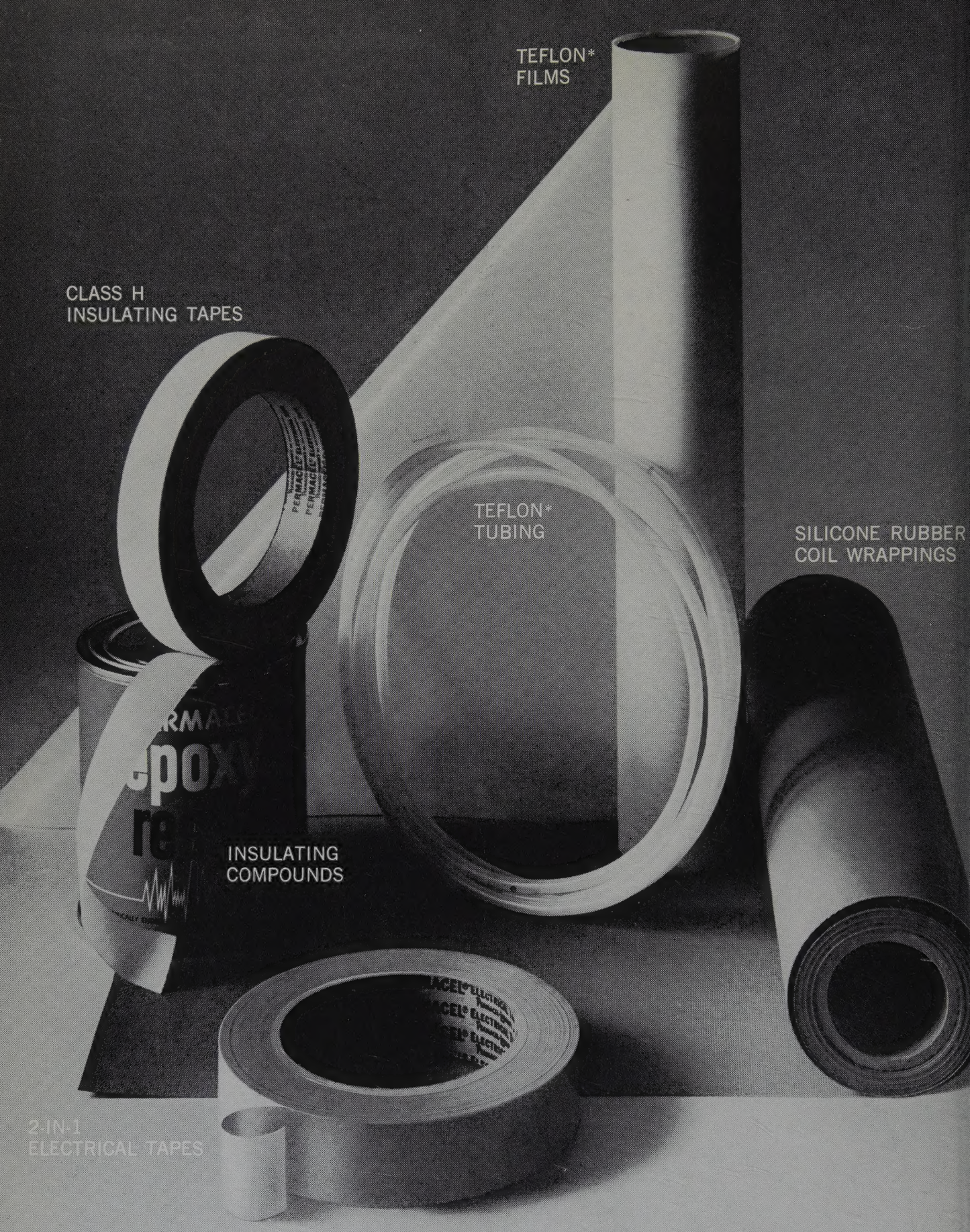
February 1961

Insulation

Cold motor . . . page 17

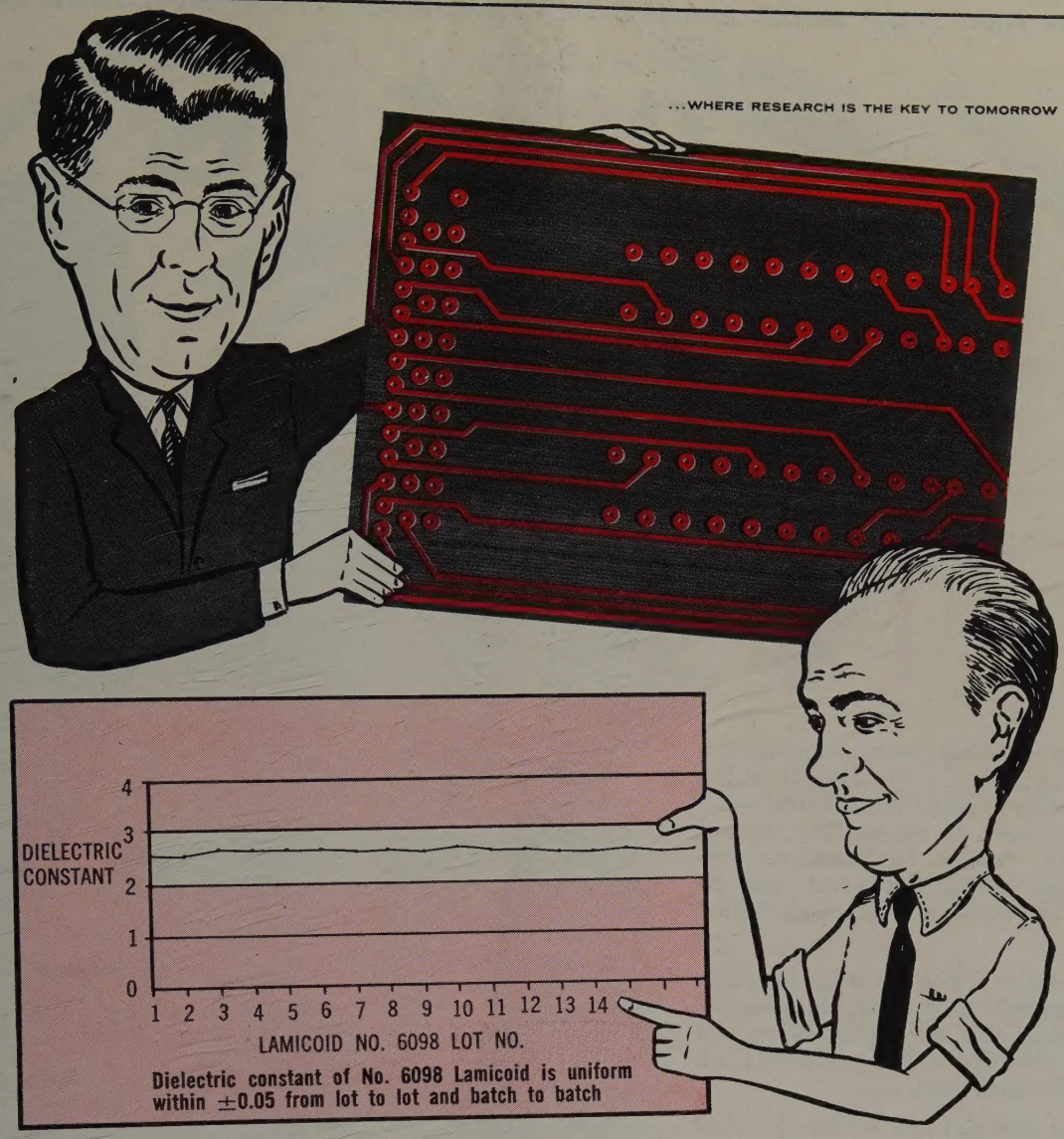
In this issue:



*Du Pont Trademark

Whatever the job . . . **PERMACEL®**

NEW BRUNSWICK, NEW JERSEY • TAPES • ELECTRICAL INSULATING MATERIALS • ADHESIVES



for low losses and high reliability in Microwave and UHF assemblies

NEW TEFLON GLASS No. 6098 or CUCLAD TEFLON GLASS LAMICOID

combines these properties

- CONTROLLED DIELECTRIC CONSTANT
- READILY MACHINED TO CLOSE TOLERANCES
- EASILY SOLDERED
- SHOCK RESISTANT
- LOW LOSSES OVER WIDE FREQUENCY RANGE
- EXTREME CHEMICAL AND ABRASION RESISTANCE
- HIGH HEAT RESISTANCE (250 C Continous)

Because it minimizes dielectric losses, NO. 6098 Teflon* Glass LAMICOID is ideal for printed circuits in airborne micro-wave and UHF assemblies, where miniaturization and high reliability are essential. Available plain or with 1 or 2-ounce copper foil bonded to one or both sides, the new laminate is extremely uniform, rugged and thermally stable. *Dielectric constant can be varied to suit your requirements.*

FOR COMPLETE DATA on NO. 6098 Teflon Glass LAMICOID, write to Mica Insulator, Division of Minnesota Mining & Mfg. Co., 11 Broadway, Schenectady 1, N. Y.

MICO ELECTRICAL INSULATION

MICA INSULATOR

DIVISION OF MINNESOTA MINING & MFG. CO.

SCHENECTADY 1, NEW YORK

MICANITE® AND ISOMICA® PRODUCTS LAMICOID® LAMINATES
SILICONE AND TEFLON* COATED CLOTHS AND TAPES
* Reg. T. M. E. I. DuPont de Nemours & Company

Print Ins. 2 on Reader Service Card

Print Ins. 1 on Reader Service Card

MACALLEN BUILT-UP MICA MAKES BETTER INSULATION BECAUSE IT'S

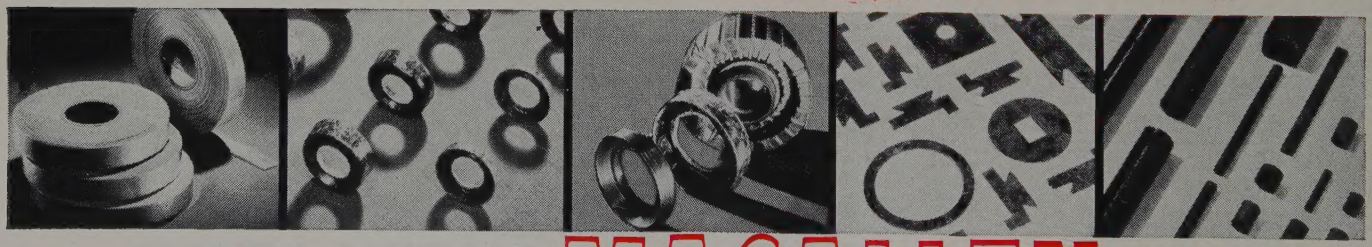
VersAtiLe

WHATEVER YOUR INSULATING REQUIREMENTS, you can meet them with Macallen Built-Up Mica. It comes in many forms and sizes — from tubes, tapes to sheets. The amount of flexibility, rigidity, hardness, compressiveness, and physical strength can be varied. It can be sawed, punched, drilled or molded.

And Macallen Built-Up Mica is *tough.* It has extremely high dielectric strength, excellent resistivity, low dielectric loss and maximum stability under practically all atmospheric conditions.

No other material has all the electrical insulation qualities of mica. And no one knows how to make better use of them than Macallen.

Find out how Macallen Built-Up Mica can solve your insulation problems. Write for Catalog 26 today. No charge or obligation.



For the most in mica — specify Macallen . . .

MACALLEN MICA

The first name in mica for more than 60 years.

THE MACALLEN COMPANY

Bay Road • Newmarket • N.H.

Chicago: 565 W. Washington Blvd. • Cleveland: 1231 Superior Avenue, N.E.

Print Ins. 3 on Reader Service Card

Insulation

For the Electrical and Electronic Industries

Lake Publishing Corporation, 311 East Park Avenue, Libertyville, Illinois, February 1961
Publishers of Insulation, Insulation Directory/Encyclopedia Issue, Plastics Design & Processing

Circulation Policy and Subscriptions: Insulation is distributed without charge within the United States to qualified users of electrical and electronic insulating materials engaged in design and specifying work covering the use of insulation. Subscription rates to others within the United States and U.S. Possessions are $0.75 per copy, $7.50 per year, and $12.00 for two years. Foreign subscriptions 50% higher. Circulation requests and inquiries should give title or department, company name, and products or services of company. Corrections should also show old company name and address.
Back Issues, when available, are charged for at the rate of $1.25 per copy for 1 to 5 copies, $1.00 per copy for 6 to 10 copies, and $0.75 per copy for 11 or more copies.

Insulation, February, 1961. Volume 7, Number 2. Published monthly, except twice a month in May, by Lake Publishing Corp.,

Box 270, 311 E. Park Ave., Libertyville, Ill. Phone EMpire 2-8711. Accepted as controlled circulation publication at Mount Morris, Illinois.

BPA Member Business Publication Audit of Circulation, Inc.

Advertising Sales Offices: See page 80.

From the Editor

Opinions and Rambling Thoughts

Don't Mourn the Coal Stove

There are those who talk wistfully of coal stoves and kerosene lamps. And there are even some whose eyes become moist with nostalgia when they think back to the cold walks in the backyard they had to take on a dark winter night before electric pumps and such hastened the acceptance of inside plumbing.

Not I.

And I doubt if you mourn the days before commercial electricity.

Television, freezers, lights, dryers, washers, movies, medical equipment, automatic can openers, motors, heaters, modern transportation systems, shavers, computers, communication systems, air conditioners . . . all these and more would be impossible without electricity.

There wouldn't even be a magazine called *Insulation.*

And you wouldn't have the job that you do.

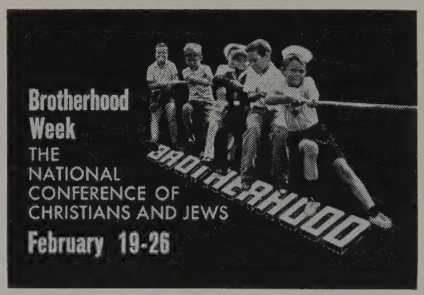
So we all have much to be thankful for . . . and we might think about this during National Electrical Week, February 5-11.

It is difficult to realize that it has been only 80 years since Thomas A. Edison invented the first practical incandescent lamp. Since his invention, the electrical industry has grown to the point where it now employs directly more than 3,000,000 persons—or 1 out of every 20 of our nation's workers. How many others owe their employment indirectly to electricity is incalculable.

The past 80 years have been a period of tremendous progress for the electrical industry. National Electrical Week, observed annually during the week of Edison's birthday, provides the opportunity for looking pridefully at the record of progress . . . and for each of us resolving to do our part to rededicate the industry to continuing progress and service to the nation.

Brotherhood

Another special week this month is "Brotherhood Week" which will be observed February 19-26. You might ask why a business magazine should even devote space to brotherhood. The answer is simple—brotherhood is everyone's business—yours and mine.



As far as I am concerned, brotherhood is respect. Once we learn to respect others, your color, your religion, or the way you comb your hair lose all significance as criteria for the judgment by one person of another. Let's remember to do our part to earn the respect of others by respecting them.

A Pat on the Back for Dow

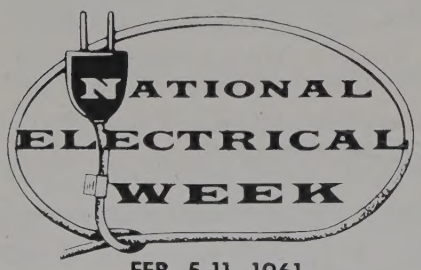
We note that Dow Chemical Co. has increased polystyrene prices in most categories over those published by other manufacturers in recent times. We are not in a position to judge whether most price increases and decreases are justified or not but we do know that some segments of the plastics and other industries have been unable to maintain fair profit margins because of price cutting. As Dow points out, prices which are too low can bring about reduced development of new uses as well as reduced materials research.

Allis-Chalmers Manufacturing Co. also deserves a pat on the back for its announcement of increased selling prices for large induction motors along with a new sales policy of one price to all classes of purchasers. This is designed to eliminate the generally chaotic conditions in the market which have resulted in a variance between published net prices and actual selling prices. It would be well for all industries to follow this lead—discounts from published prices do not lead to long-lasting friendships . . . the buyer always figures that someone else is probably getting an even bigger discount.

Insulation Standards Laboratory

Efforts are being made to establish an Electrical Insulation Industry Standards Laboratory on a non-profit basis. Donations will shortly be solicited from industry to establish the laboratory. It is anticipated that the

laboratory facilities would be available on a fee basis for a variety of different types of work—system tests, development and research, standardization, material evaluation, etc. More information may be obtained by contacting Carl Christiansen, 11 Lakewood Drive, Ridge Manor, Fla.



colored · marked · quick · tough · cut lengths · self extinguishing · flexible

HEAT-SHRINKABLE

THERMOFIT® RNF

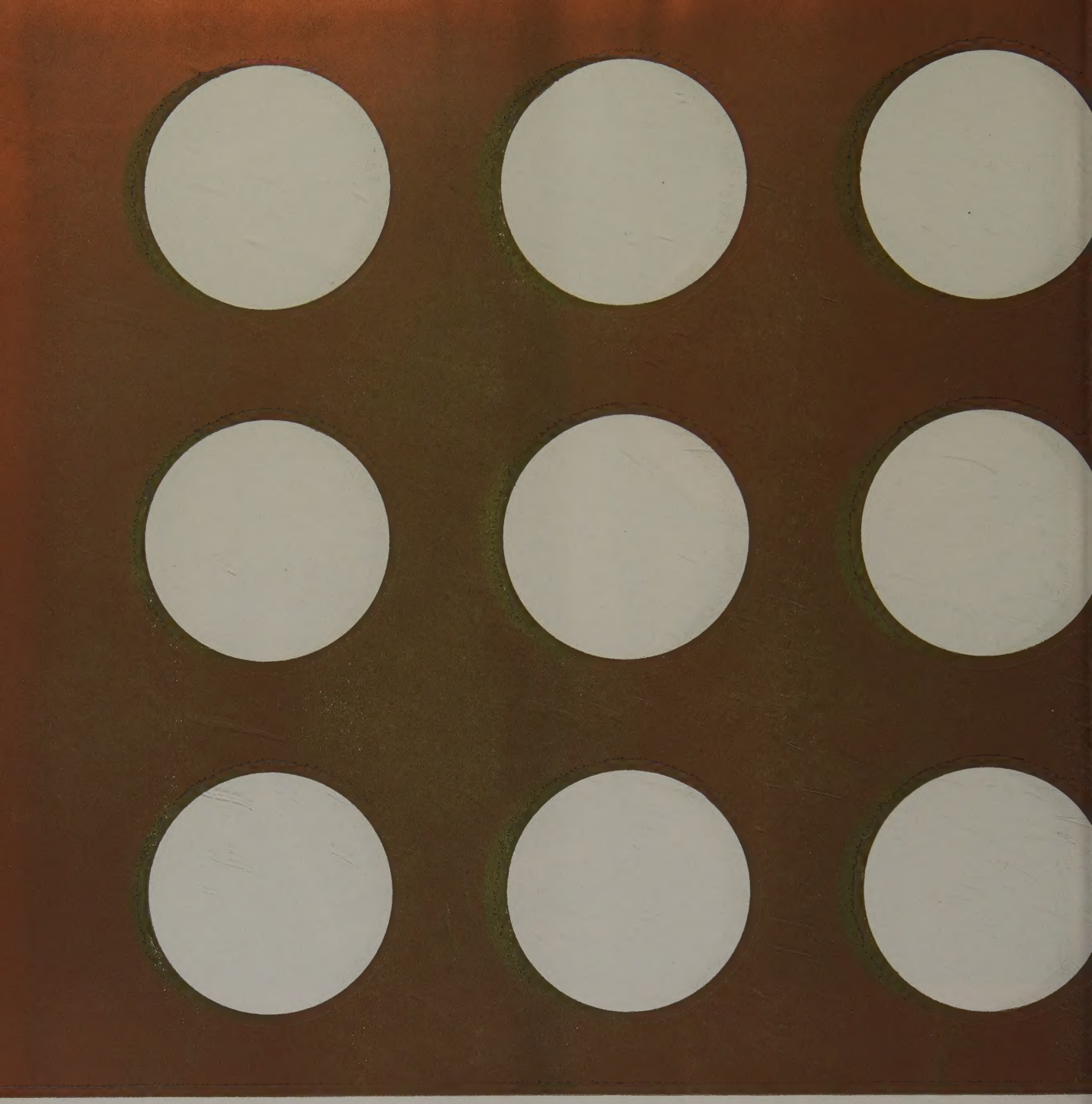
MARKED AND COLORED SLEEVES FOR EASY IDENTIFICATION

RAYCLAD TUBES
INCORPORATED

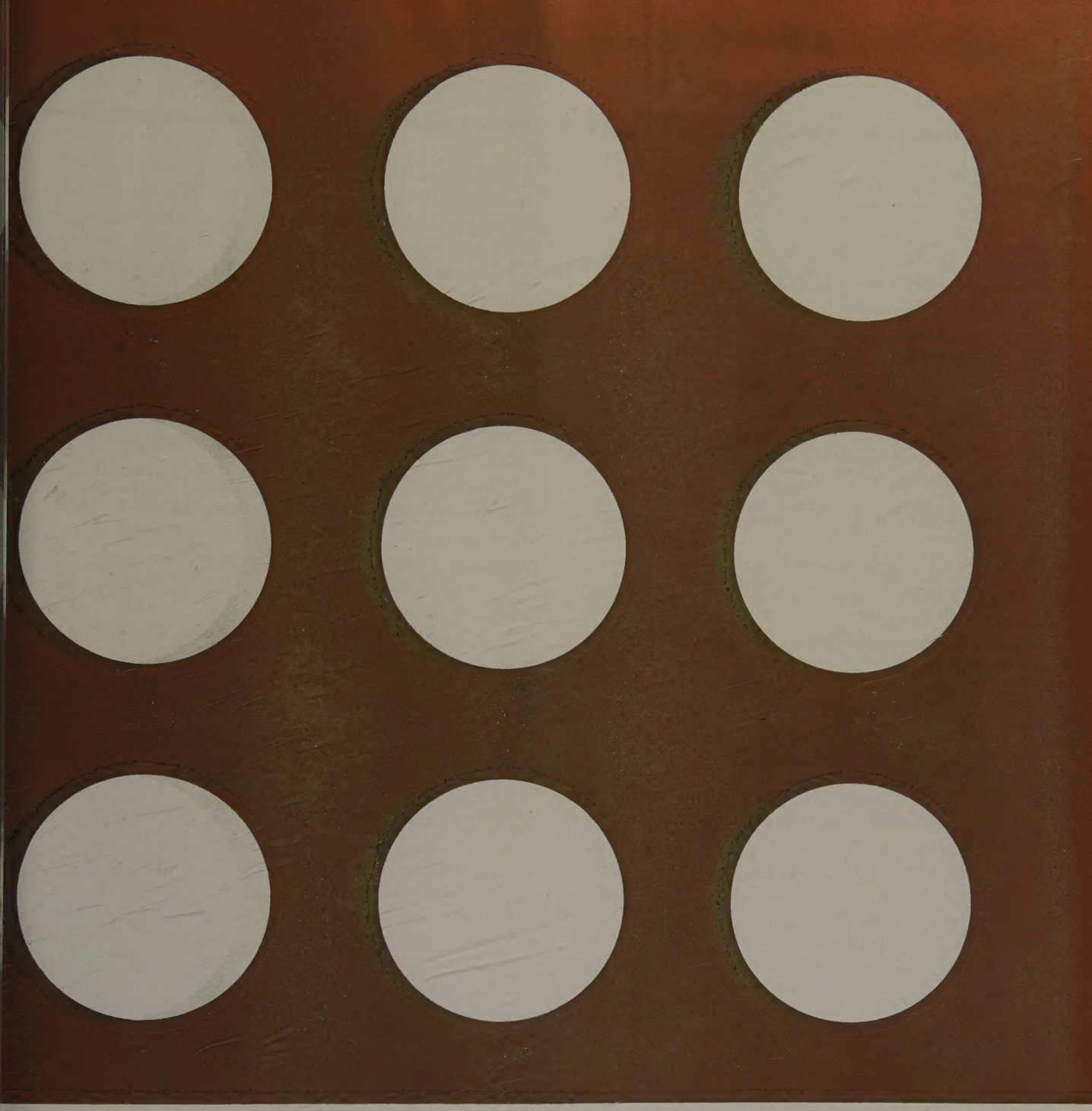
To easily identify and insulate wire, connectors, terminations and other circuitry elements, Rayclad Tubes Incorporated now has Thermofit RNF available in preprinted shrinkable sleeve form. Standard colors of Thermofit sleeving can be supplied marked and cut to customer specifications.

OAKSIDE AT NORTHSIDE • REDWOOD CITY, CALIFORNIA

Print Ins. 4 on Reader Service Card



J-06703



NEW FROM WESTINGHOUSE MICARTA

Micarta has the copper clad you have asked for. It is a fire-resistant paper base laminate you can cold punch precisely. Warp-free, it remains flat throughout your entire process. Its other properties include high impact, flexural and bond strengths, high insulation resistance and low water absorption. The grade? Micarta 65M06, one of seven superior copper clad laminates available immediately from Westinghouse Micarta.

For complete data and samples, call the nearest Micarta Fabricators Association member or Westinghouse Sales office. Check the Yellow Pages. Or contact Westinghouse Electric Corporation, Micarta Division, Hampton, South Carolina. You can be sure . . . if it's Westinghouse.

Print Ins. 5 on Reader Service Card

Micarta makes solid, flexible and liquid materials for all your insulation needs.

News and Views

Ceramic Fiber Becomes Standard Product

As of the first of the year, Carborundum Company's "Fiberfrax" ceramic fiber becomes a standard product of the firm's Refractories Division, indicating that the material has successfully passed through the pilot plant and field testing stages. Because of its high heat resistance (2300°F continuous), there is some interest in the material for electrical insulation purposes—the fibers are already being used in a few specialized electrical applications. The fibers can be used in paper, fabrics, braided sleevings, molded parts, etc.

More Polyethylene

Production of polyethylene is now underway in a new plant at Dow Chemical Company's Louisiana Division in Plaquemine. The new operation is the third Dow producing point for polyethylene—others are at Freeport, Texas, and Bay City, Mich.

AIEE to Try Exposition

The American Institute of Electrical Engineers, which has long been reluctant in respect to sponsoring a national exposition, has announced plans for the first Electrical Engineering Exposition, to be held Jan. 29 through Feb. 2, 1962 at the New York Coliseum. The exposition will be held in conjunction with the institute's annual winter general meeting at the Statler Hotel. The decision to hold the exposition was made after a survey of AIEE members at last year's winter meeting showed that 57% definitely wanted commercial exhibits to supplement technical sessions.

Patent Granted Covering New Molding Process for Sintered TFE

Continental-Diamond Fibre Corp. has been granted a patent covering a new molding process for sintered polytetrafluoroethylene articles which reportedly produces sound, compact molded billets, free from porosity, cracks, and leathery texture, even when reclaimed sintered material is used. Dielectric strength properties superior to those of products produced by conventional methods are claimed. The material can be skived in the usual way to give sound, continuous sheet material.

NEMA Reports 5% Increase for 1960; 1961 Viewed with Caution

The electrical manufacturing industry reached a new all-time high of $22,622,300,000 as the value of factory shipments in 1960—an increase of 5% over the 1959 mark of $21,522,900,000, according to the National Electrical Manufacturers Association. However, NEMA is viewing 1961 with considerable caution and is giving readers a choice of possible predictions, to wit: business could rise slightly to $22,795,500,000; remain at 1960 levels; or drift downward by as much as 5%. Much depends on the anticipated gain in the economy in the last half of 1961 since most electrical manufacturers forecast a slow first half. The table below shows the total shipments in millions of dollars for the electrical manufacturing industry:

	1960	*% '60/'59*	*1961 Estim.*	*% '61/'60*
Consumer products	$5,661.4	— 5	$5,803.0	+2.5
Lighting equip.	1,516.8	+ 3	1,516.8	0
Industrial electronics & communic. equip.	7,019.2	+20	7,194.7	+2.5
Industrial equip.	3,615.7	+ 5	3,543.4	—2
Bldg. equip.	788.7	+ 3	772.9	—2
Insul. materials	410.5	0	431.0	+5
Wire & cable	1,430.6	— 5	1,430.6	0
Gener., transm. & distrib. equip.	2,179.4	+ 3	2,103.1	—3.5
TOTAL	22,622.3	+ 5	22,795.5	0

Other Business Forecasts and Reviews

In a year-end statement, the Aerospace Industries Association reports that 1960 sales are estimated at about $11-billion, approximately the same as in 1959. It is expected that 1961 sales will continue at this same level. Missile spending will continue to increase while aircraft spending will decrease proportionately.

According to W. R. Grace & Co., in 1960 polyethylene was again the pacesetter in the plastics industry with estimated sales of 1,260,000,000 pounds. High density polyethylene sales reportedly were about 180,000,000 pounds, nearly double the 98,000,000 figure for 1959. The total for the high density material in 1961 is expected to be 287,000,000 pounds. Wire and cable insulation is one of the most promising applications with jacketing and insulation for telephone and power cables appearing particularly bright.

Reports from most of the larger companies are forecasting slightly increased sales for 1961 over 1960. However, the profit squeeze is expected to continue. It is interesting to note that in these times of reduced profits, industry apparently is pouring more money into research in the hopes of coming up with new products which can return healthier profits. All in all, the first half of 1961 is expected to remain at the present level. There should be a gradual pick-up in the last half.

SUITABLE FOR 105°C SERVICE

VARTEX R-191

protection & insulation

in high-heat flexible extruded tubing

This versatile UL-listed tubing has exceptional electrical and physical properties for applications over a temperature range up to 105°C. Its protective and insulating qualities and unusual flexibility make it ideal for leads, connections and allied uses. A broad selection of colors and standard ASTM sizes are available. R191 Vartex conforms to ASTM D922-54-T (Grade C) and meets the requirements of MIL-I-631C, Type F, Grade C, Classes 1 and 2, category 1. Millions of feet of Vartex are meeting the most difficult field conditions.

OTHER VARTEX TYPES		
	R60	Designed to conform to MIL-I-631C, Grades A and B, classes 1 and 2, category 1. Also conforms to ASTM D922-54-T (Grade A).
	R100	Designed to conform to MIL-I-7444B.
	R54	For general purpose applications.

njw

NEW JERSEY WOOD FINISHING COMPANY

MANUFACTURERS OF FLEXIBLE ELECTRICAL INSULATION • WOODBRIDGE, N. J.

VARNISHED CAMBRIC CLOTH AND TAPES • VARNISHED "FIBERGLAS"† CLOTH AND TAPES • VARNISHED SILK AND SILK SUBSTITUTE • SYNTHETIC RESINOUS TAPES AND EXTRUDED TUBING • POLYETHYLENE, SHEETS, TAPES AND EXTRUDED TUBING • CABLE WRAPPING TAPES • "VARSIL" SILICONE VARNISHED "FIBERGLAS"† CLOTH AND TAPES • "VARSLOT" COMBINATION SLOT INSULATION: – RAG PAPER AND VARTEX VARNISHED CAMBRIC • FISH PAPER AND VARTEX VARNISHED CAMBRIC • RAG PAPER AND "MYLAR"* POLYESTER FILM • ASBESTOS PAPER AND "MYLAR"* POLYESTER FILM • KRAFT PAPER AND "MYLAR"* POLYESTER FILM • VARTEX VARNISHED "FIBERGLAS"† AND "MYLAR"* POLYESTER FILM • SPECIAL COMBINATIONS AVAILABLE UPON REQUEST.

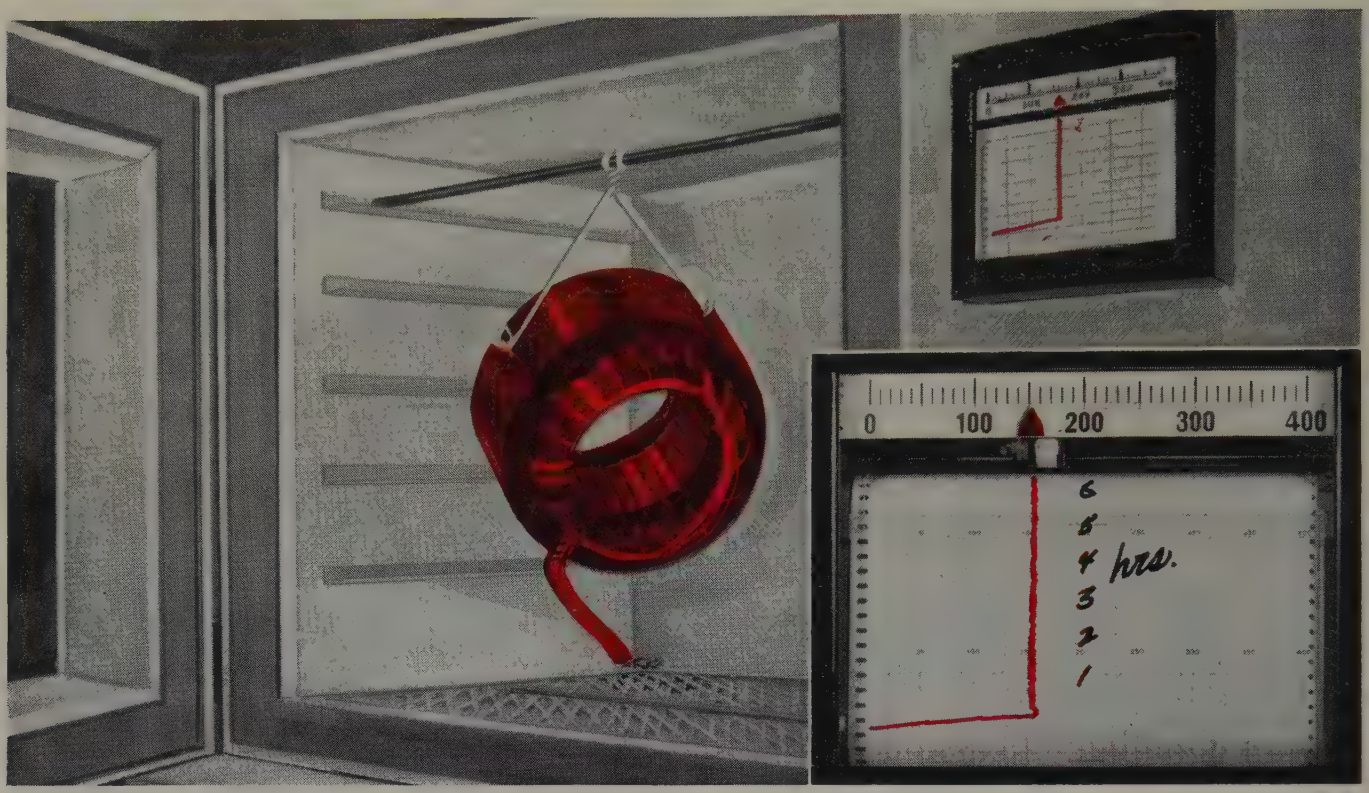
*Mylar, DuPont's registered trademark

†Fiberglas, Owens-Corning Fiberglas registered trademark

Print Ins. 6 on Reader Service Card

SILICONE NEWS from Dow Corning

New Silicone Varnishes



Simplify Processing of Equipment With Low Temperature Cure Silicones

New Dow Corning Silicone Varnishes facilitate quicker, lower-cost processing of silicone insulation systems for motors, transformers and electronic units. Reason: these new varnishes cure in only six hours at 150 C . . . develop full bond strength at 50 C less than conventional high temperature curing silicone varnishes.

Manufacturers equipped for Class A or B insulation systems are *automatically* equipped to handle these new Dow Corning low-temperature-bake Class H varnishes.

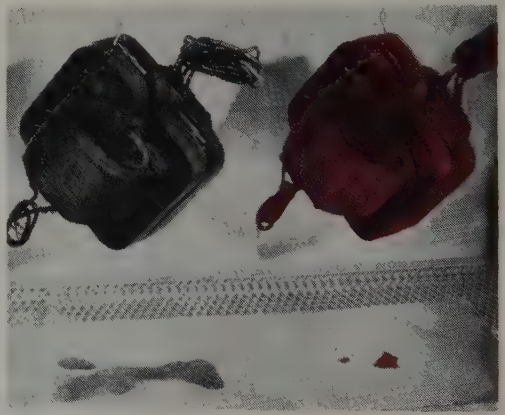
There are other advantages. Run-off is very slight. Compared to other varnishes, the new silicone varnishes give adequate buildup to the desired insulation thickness while reducing varnish waste and cleanup time. Result: big savings in processing time and equipment maintenance.

Heat stability is even better than for silicone varnishes previously available. The new varnishes meet AIEE heat stability requirements for both 180 C and 220 C systems, resist moisture and are unaffected by many corrosive atmospheres.

When used with other silicone insulating components, the new Dow Corning Silicone Varnishes help make motors, transformers and electronic servo-mechanisms smaller, lighter, more reliable and virtually maintenance-free. Write today for complete data.

Less Runoff, Other Advantages

In addition to curing in 6 hours at 150 C, the new Varnishes have excellent tank stability and will not soften, swell or deteri-



orate most insulating materials, including silicone rubber. They combine good penetration with low run-off and low curing temperatures . . . features that add up to substantial economies.

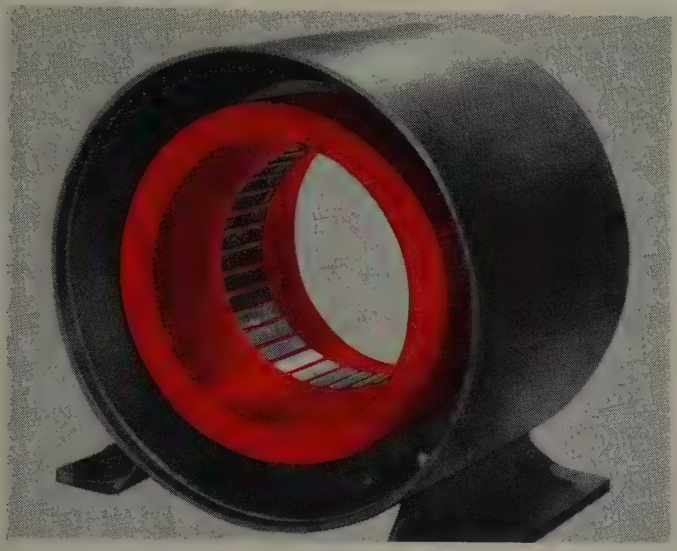
Print Ins. 7A on Reader Service Card

The nearest Dow Corning office is your number one source for information and technical service on silicones.

first in silicones

Dow Corning

...upgrade equipment performance



Fulltime, Resilient Protection

Encapsulating these motor end turns with Silastic® RTV, the fluid silicone rubber that cures without heat, produces a clean-cut, void-free protective jacket that locks out dust, dirt, moisture, abrasives, many chemicals and corrosive atmospheres.

The Silastic RTV used in this application pours bubble-free . . . flows smoothly into all crevices . . . leaves no weakening air holes. It bonds tightly to primed surfaces and vulcanizes into a void-free, homogenous silicone rubber wall.

Silastic RTV expands and contracts with windings and laminations . . . will not hairline crack . . . is equally suitable for Class A, B, F, or H insulation systems.

Print Ins. 7B on Reader Service Card

Assure Lubricity at 300 F

Engineers take no chances with the bearings in these anode feed motors. Proper operation is vital to production, and *ambients are in the order of 300 F!* That's why Dow Corning silicone lubricants are specified for the ball bearings on all 960 motors.

The reason: silicone grease won't bleed out, run off or carbonize when high ambients push operating temperatures beyond the safe limits of ordinary greases. Dow Corning silicone lubricants remain effective long after the best organic oils and greases have oxidized . . . give products exceptionally long "shelf life" . . . keep warranty costs low . . . assure trouble-free operation regardless of temperature or length of service.

Print Ins. 7C on Reader Service Card

Contact the nearest Dow Corning Authorized Distributor. He's your best source for Silastic RTV and other quality-produced, performance-engineered silicone materials.

first in silicones
Dow Corning
SILICONE INSULATION
AUTHORIZED DISTRIBUTOR

Allied Electrical Insulation, Inc.
East Rochester, N. Y.

Brownell Electrical Insulation
New York 11, N. Y.

Butts Electric Supply Company
Oklahoma City, Oklahoma

C. D. LaMoree Company
Los Angeles 15, California

C. E. Riggs, Inc.
Portland, Oregon

Earl B. Beach Company
Pittsburgh 21, Pennsylvania

E & H Electric Supply Co.
Louisville 3, Kentucky

Electrical Insulation Suppliers, Inc.
Atlanta, Georgia

Electrical Maintenance Equipment Co.
Philadelphia 23, Pennsylvania

Insulation and Wires Incorporated
St. Paul 1, Minnesota

Insulation Manufacturers Corporation
Chicago 6, Illinois

J. R. Christensen Agency
Salt Lake City 11, Utah

McNaughton-McKay
Detroit 4, Michigan

National Electric Coil Company
Columbus 16, Ohio

Prehler Electrical Insulation Co.
Chicago 39, Illinois

Robert McKeown Company, Inc.
Livingston, New Jersey

Summers Electric Company
Dallas 1, Texas

The Electric Motor Supply Co.
Baltimore 2, Maryland

The Huse-Liberty Mica Company
Peabody, Massachusetts

Tri State Supply Corporation
Los Angeles 13, California

White Supply Company
St. Louis 10, Missouri

CORPORATION MIDLAND, MICHIGAN

branches: ATLANTA BOSTON CHICAGO CLEVELAND DALLAS LOS ANGELES NEW YORK WASHINGTON, D.C.

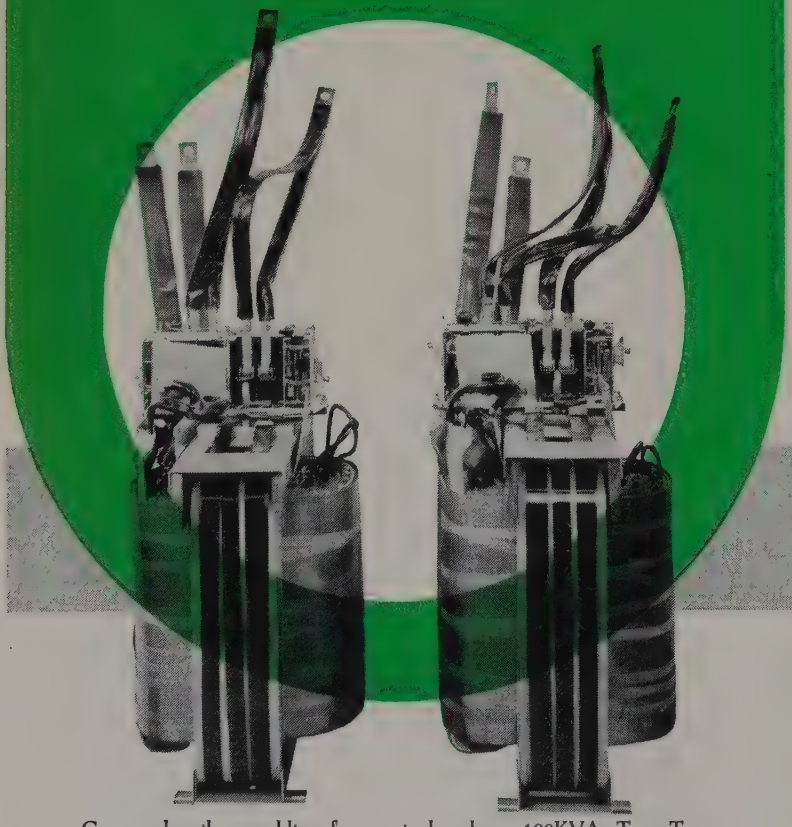
RT&E

TRANSFORMER LEADS

are insulated and protected with

NATVAR 400

EXTRUDED VINYL TUBING



Core and coil assemblies for a single phase 100KVA Terra-Tran, R T & E's oil immersed, self-cooled, completely self-contained transformer for residential underground distribution. Natvar 400 extruded vinyl tubing is used on both high voltage and low voltage leads to provide superior mechanical and electrical protection.

Distribution transformers manufactured by *R T & E Corporation*, Waukesha, Wisconsin, have established an outstanding reliability record. R T & E's rigid engineering standards demand the best electrical design factors to maintain a safe insulation level even after years of heavy duty service.

R T & E uses Natvar 400 extruded vinyl tubing to insulate transformer leads because of its excellent electrical properties and resistance to oil and heat

If you need flexible electrical insulation with exceptional uniformity, electrical and physical characteristics, it will pay you to use Natvar — available through your wholesaler, or direct from us.

Natvar

Natvar Products

- Varnished cambric—sheet and tape
- Varnished canvas and duck—sheet and tape
- Varnished silk and special rayon—sheet and tape
- Varnished papers—rope and kraft—sheet and tape
- Varnished, silicone varnished and silicone rubber coated Fiberglas*—sheet and tape
- Slot cell combinations, Aboglas®
- Teraglas®
- Isoglas® sheet and tape
- Isolastane® sheet, tape, tubing and sleeving
- Vinyl coated and silicone rubber coated Fiberglas tubing and sleeving
- Extruded vinyl tubing and tape
- Styroflex® flexible polystyrene tape
- Extruded identification markers

*TM (Reg. U.S. Pat. Off.) OCF Corp.

We will be very happy to supply information on any of our products on request.

NATVAR CORPORATION

FORMERLY THE NATIONAL VARNISHED PRODUCTS CORPORATION

Telephone	TWX	Cable Address
FULTON 8-8800	RAHWAY, N.J., RAH 1134	NATVAR: RAHWAY, N.J.

239 RANDOLPH AVENUE • WOODBRIDGE, NEW JERSEY

Print Ins. 8 on Reader Service Card

Pixilated Patents

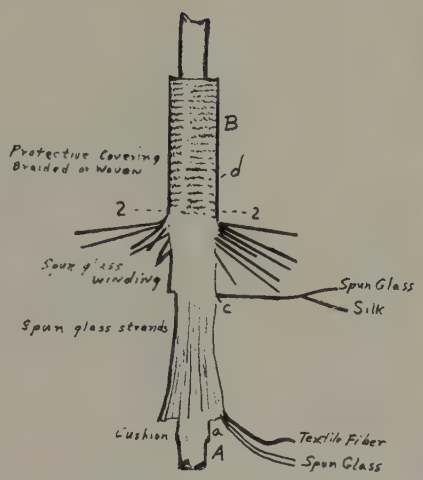
By Mike Rivise

(Fiftieth in a series of odd and interesting inventions in the electronics field from the files of the U.S. Patent Office.)

This month we are departing from our usual practice of describing an invention that appears amusing in the light of present-day knowledge. The glass fiber insulation patented by Thomas S. Reed of Jersey City, N.J., on April Fool's Day, 1890, would not be considered pixilated today because of what is now known about the properties of glass and about modern production processes. However, it must have seemed to be definitely daffy to his contemporaries.

Regarding properties, Reed confidently stated in patent 424,575 that, "My improved insulation has the following advantages: Being of glass, it is not affected by ordinary acids, nor by gaseous fumes, nor by corrosive liquids. It cannot decay or deteriorate through lapse of time. It is non-corrosive. It is water-proof, not being affected by moisture or liquid, and is practically impervious thereto. It is non-inflammable, and is unaffected by heat until the latter approaches nearly or quite to the melting-point of glass. It is perfectly flexible, like any fibrous insulating-covering, and the material of which it is made possesses a higher resistance to the passage of electrical currents than any other insulating material."

The construction of the insulation is described by Reed as follows: "I first cover the wire or conductor with a layer of wool, cotton, or other soft textile fiber by winding a loosely-twisted thread or yarn thereon spirally wound around the conductor. I thus form a soft or yielding cushion of peculiar character, over which the insulating-layer of spun glass is applied, preferably by forming the spun glass into loosely-twisted strands or yarns and applying the same under light tension around the pad or cushion. Where a single layer only of insulation is to be applied, strands or yarns



of spun glass are laid longitudinally around the conductor, and are held in place thereagainst by means of an outer layer of any material of sufficient strength wound, braided, or otherwise applied in such manner as to bind said filaments against the conductor. In case two or more layers of insulating material are required, the first layer is applied, preferably, in the same manner—namely, by laying the filaments longitudinally on the conductor or in any suitable manner —and a second layer of spun-glass filaments is applied by winding a strand, yarn, or thread of spun glass spirally around the first layer.

"In the case of any part of the insulating-cover which is subjected to any considerable strain or wear, and preferably, also, in the case of all portions of the insulating-covering wherein spun glass is employed, I make the strands or yarns not of spun glass alone, but of filaments of spun glass combined with filaments or fibers of silk or other suitable textile fiber of animal or vegetable origin, the combined filaments being loosely twisted or spun together."

In the illustration, A is the wire conductor, a is the soft cushion of fibrous material, b is the layer of strands of spun glass, c is a second insulating layer of spiral spun-glass thread or yarn, and d is a braided or woven protective covering.

Insulation Forum

This regular monthly feature is built around a timely question concerning the electrical insulation field. Your suggestions for future questions and participation are invited. This month's question is:

What do you expect will happen to business conditions in your area of the electrical/electronic field during the coming year?

John Heady

Buyer, Mechtron Div., Tensolite Insulated Wire Co. Inc., Peekskill, N.Y.

"The year 1961 has many economists pondering the question of what business conditions will be like. In our field of "Teflon" insulated wire, cable, and harness assemblies the outlook for 1961 seems to be very promising. Generally speaking, new orders seem to be holding a firm line and increases are expected for the second half of the year.

"Today the advances in the electrical and electronic fields are introducing many new and varied products to the world. With each advance comes opportunities for expansion in many fields within the industry. Of course these expansions will come in 1961 as they have in the past years.

"The need for cable and harness assemblies, and for electronic components, has in itself become a rather large industry due to the increased use of electrical power over manually operated equipment. Today's aircraft, missiles, submarines, etc., are using miles of wire and cable coupled with electronic equipment never thought possible until a short time ago. The use of electrical and electronic components has grown tremendously over the past 10 years and the prospects of increased usage seem to be apparent in the years to come.

"All the projects for missile programs have been a shot in the arm for many industries in our field. With "The Race For Space" still being of prime importance to the defense of our country, the business prospects from this field alone would indeed warrant a good outlook for 1961.

"The question of federal expenditures under the new administration will be a big factor in the overall picture. A very basic look at this situation would point to increased expenditures for all defense programs. This of course would not be felt until the second half of the year but could have a very decided effect on business conditions.

"The stabilizing of inventories should be completed by most firms at this time. Pessimistic views towards the outlook of business have caused many firms to cut inventories sharply. This cut-back has, of course, been a determining factor in the overall production output. The year 1961 should see a more stabilized business picture since, generally speaking, the slack has been taken in on these inventory cut backs.

V. Gross

President, Sterling Transformer Corp., Brooklyn, N.Y.

"We are looking forward to a year showing some improvement over 1960. With a slow start early in the year, we expect volume to build steadily to the end of the year. Quoting and planning activity of the last months of 1960 presages this up-swing pattern for 1961. We find that many of our customers are expecting some help from the new administration in Washington this year. This "wait and see" attitude has had a damping effect on business plans. These plans, we feel, will be triggered into action as soon

as there are *any* positive moves from Washington to encourage the electrical and electronic industries.

"We will continue to use this period of relatively light business to improve our methods and re-educate our staff so that we will be ready to take maximum advantage of growing volume through 1961. Planning for an expanding future is important for every segment of our industry that wishes to move with this new groundswell of business."

H. C. Harris

Director of Purchasing, Westwood Cable Corp., Los Angeles.

"The remarkable and fantastic growth in both the electrical and electronic fields in Southern California of recent years is now on the brink of providing the momentum for new horizons and new starting points for even further advancements and increased activity. We look forward to a year of increased activity due to our expansion plans and new recent developments which are now off the drawing boards. New high temperature applications present ever broadening prospects for increased business. The year 1961 will doubtless be a year of increased competition, but we are quite optimistic for increased sales because of our regular line of products and newest developments. Southern California and the Southwest should show a marked improvement in business."

Correction

In the World-Wide Insulation Report on *Insulation in Canada* which appeared in the December issue of *Insulation*, two zeros were inadvertently omitted from the figure giving the annual per capita consumption of electrical energy in the US as 45 kwh. This should have been 4500 kwh (actual figures just released quote 4007 kwh).

"Is that the new Norton catalog?"

You bet it is!

It's dog-eared and marked up because it's in constant use by men who want better materials — high purity refractory materials which will stand up under the most extreme thermal, mechanical, chemical, electrical, and radioactive conditions.

This valuable, well-illustrated reference describes in detail the many Norton refractory materials which are helping to solve widely different product and processing problems. Uses range from aiding chemical reactions to stopping neutrons, handling molten metals, protecting rocket engines — and taming lightning.

Catalog lists physical, chemical and electrical properties of CRYSTOLON* Silicon Carbide, ALUNDUM* Aluminum Oxide, MAGNORITE* Magnesium Oxide, NORBIDE* Boron Carbide, and Fused Zirconia. It's thought-provoking...a real "idea-starter!"

You may well profit from this book in solving your own processing problems. No charge or obligation, of course, write for "Norton Refractory Grain," NORTON COMPANY, Refractories Division, 581 New Bond St., Worcester 6, Mass.

*Trade-Marks Reg. U.S. Pat. Off. and Foreign Countries

NORTON
REFRACTORIES
Engineered... Rx ...Prescribed

75 years of... Making better products . . . to make your products better

NORTON PRODUCTS: Abrasives • Grinding Wheels • Machine Tools • Refractories • Electro-Chemicals — **BEHR-MANNING DIVISION:** Coated Abrasives • Sharpening Stones • Pressure-Sensitive Tapes

Print Ins. 12 on Reader Service Card

New Developments in Epoxy Resins

Part 3—Selecting an Epoxy Resin for Encapsulating Motors

By Dr. Henry Lee, Technical Director, The Epoxylite Corp., South El Monte, Calif., and Carl Hackney, Norwood (Ohio) Works, Allis-Chalmers Mfg. Co.

The new epoxy resins have fostered amazing changes in insulation concepts in the past 5 years. They have permitted the development of insulation systems having toughness, chemical resistance, moisture resistance, aging life, and high temperature bonding strengths far surpassing combinations previously available to the electrical insulation specialist.

With the rapid acceptance of epoxy resins, there has been a tendency to view them as "cure-alls," rather than as the versatile, new engineering materials which they are. Too often, engineers come to expect the resins to solve all of their design problems at once—perhaps merely because the resins are "new," rather than because so many applications have succeeded. Too often, the electrical designer merely puts the note "epoxy resin" on his print and expects immediate and positive results.

This is not the case, however. Epoxy resin formulation and application engineering is an exacting science. It is just as detailed and exacting as electric motor winding design. No electrical designer would be satisfied to release a detailed electrical print with the designation "electrical winding." If he did, he would probably get a "standard" three phase, four pole, 220/440 volt, 60 cps, Y hookup, and be very much surprised when he didn't get the performance of a winding which would give him a part-winding, full-voltage start and a 3600 rpm operating speed. Yet such obvious misapplication is exactly what happens in many cases of attempts at applying epoxy resins.

The need for careful examination of many engineering criteria in the application of epoxy resins, as well as the need for close working cooperation between the epoxy chemical specialist and the electrical insulation engineer is of utmost importance.

As a case in point, various aspects of the development of compound #293, and the *Super-Seal* encapsulated integral horsepower motors by Allis-Chalmers are detailed.

The integral horsepower a-c motors that can be obtained with epoxy resin encapsulated stators range in power from 1 hp to 150 hp. They vary in size from bore diameters of 3½ inches up to 18 inches; in iron stack lengths of 1 inch to 20 inches; and in stack diameters of 4 inches to 36 inches. They range in weight from 15 lbs to over 1000 lbs. The motors must operate over temperatures ranging from —40°F (—40°C) in cold weather to over 300°F (150°C) in case of overload duty.

When an integral horsepower motor stator is encapsulated, the many components are all cast into one solid mass (figure 1). The encapsulating material, which by its very nature tends to be a good adhesive, bonds all of the materials into a solid unit. Because each of the components has a different coefficient of thermal expansion, various mechanical stresses are set up which the epoxy compound must be capable of absorbing without cracking and losing the effective moisture and chemical seal over the windings. Similarly, the epoxy compound must be chemically compatible with the magnet wire insulation to assure long service life at normal operating temperatures. To achieve a satisfactory encapsulated motor, numerous properties of the epoxy resin must be examined and the desired range or set of values established.

continued next page

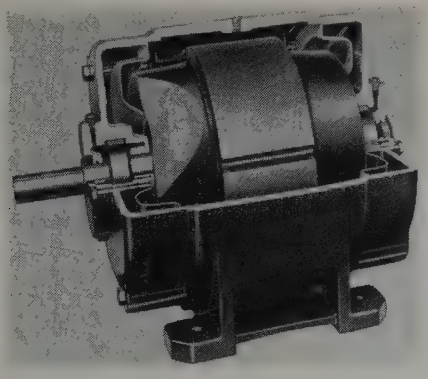


Figure 1, epoxy encapsulated integral horsepower a-c motor.

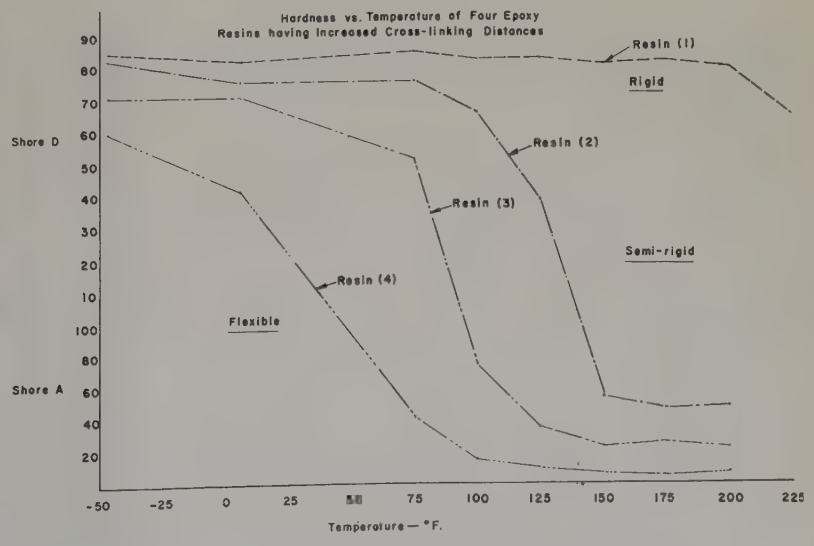


Figure 2, hardness vs temperature of four epoxy resins having increased crosslinking distances.

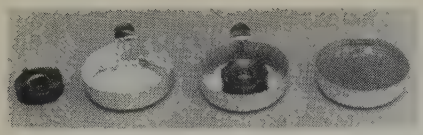


Figure 3, thermal shock test specimens.

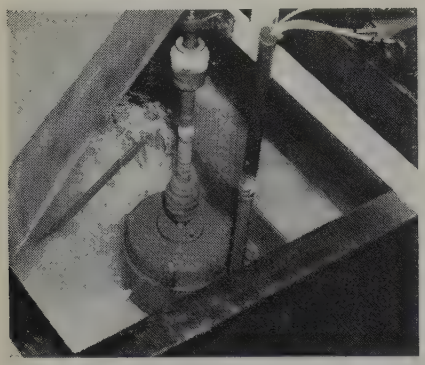


Figure 4, encapsulated motor flooded with cold saltwater while operated at full-load at 130°C for naval application.

Figure 5, encapsulated motor frozen solid in ice test.

Mechanical Properties

The mechanical properties of concern are tensile strength and percent elongation (as well as modulus of elasticity and the work or energy to break as calculated from the product of tensile strength and elongation), hardness, thermal shock resistance, thermal expansion, adhesive strength, and mechanical impact resistance.

Tensile strength and percent elongation are important in revealing the ability of the compound to carry mechanical and thermal shock loads. Hardness, or resistance to local deformations, is important in that it provides an indication of how well the system will tolerate inserts and localized distortions. Thermal expansion coefficients are important in determining the general stresses established by operating temperature changes. Adhesive strength is required to assure proper sealing to iron, copper, and various insulating materials. Mechanical impact resistance is required so that the encapsulated motor will withstand accidental mishandling in the field (as when end bells are being installed, or when coarse gravel is allowed to enter and impact). The targeted values of these properties are shown in table I.

Shore D hardness was selected as a criteria in design since initial development experiences indicated that rigid compounds as a class did not have the thermal shock resistance of less rigid compounds. Similarly, flexible epoxy resins generally were found to have insufficient mechanical strength at elevated temperatures and to possess lowered chemical resistance. Hence, it was believed that a material with a hardness lying between the two extremes of rigid and flexible, that is, a material with a "semi-rigid" nature, would prove most feasible as an engineering balance.

The hardness of epoxy resins is a function of the specific atomic structure of the resin chain as well as the distance between crosslinking or cure points. Figure 2 compares the hardness vs temperature of four experimental epoxy resins in which the distance between crosslinking points has been lengthened systematically from resin (1) to resin (4) so as to demonstrate the range of hardness which can be selected for a given application, based on a given generic resin type.

Table I

Property	Test Method	Targeted Design Values	Test Values of Compound #293
Tensile Strength at RT	ASTM	2000 psi	3500 psi
Ultimate Elongation at RT	ASTM	10%	37%
Hardness, Shore D at 75 F	Shore D	65	65
Coefficient of Thermal Expansion, in./in./C	ASTM	200 x 10^{-6}	160 x 10^{-6}
Adhesive Strength −65° F to 250° F	MIL-A 5090B	100 psi	150 psi
Falling Ball Impact Strength	MIL-I-10923	10 ft. lb.	25 ft. lb.
Thermal Shock Resistance	Olyphant Washer	90% Pass 10 Cycles 130 C to −55 C	90% Pass 10 Cycles 150 C to −75 C

Thermal Shock Tests Help Select Suitable Resins

After selection of a hardness range, seemingly suitable resins were subjected to thermal shock tests. Thermal shock testing is somewhat involved. There are numerous types of test pieces, and each type will cause a particular type failure, depending on whether the system is rigid or semi-rigid, filled or unfilled.

The three types of thermal shock tests in common use are:

1. *MIL-I-16923 Hex Bar.* A hexagonal bar about 1 inch long is potted in a cylindrical glass tube so that the buildup over the sharp edges of the hexagon is small. This test was one of the first and gives reasonable separation of very brittle systems from those with moderate thermal shock resistance. It has the advantage that cracks caused by either tension or compression occur near the surface and are readily visible. The test has the disadvantage that numerous systems will pass it, and yet may fail in the field. Over-catalyzing a resin with a polyamine curing agent will permit passing of the test, but loss of tensile strength during heat aging of

the compound in the field use will cause failure of components under much less severe thermal shock.

2. *Coffee Cup Test.* A nut and bolt are potted in a coffee cup, the cup being peeled away after cure. Two methods of shocking are used, either a cold chamber or an alcohol—dry ice bath. The cold chamber is less severe and is most representative of field service. Most commercial semi-rigid epoxy resins will fail at the —75°F (—59°C) point in this test. The stator system being used experimentally by one German manufacturer, also fails at the —75°F point. Compound #293, as finally developed, will withstand 5 cycles from 77°F (25°C) to —55°F (—48°C), 5 cycles from 77°F (25°C) to —75°F (—59°C), and 5 cycles from 77°F (25°C) to —90°F (—68°C) under this test.

The wet bath test for the coffee cup specimen is much faster but favors highly filled systems, since their coefficient of thermal expansion is lower. However, such highly filled systems fail in tests intended to measure their tensile strength in thermal shock.

Although the coffee cup test is rapid and economical, the disadvantage with this type specimen is that filled resins must be cut open to observe cracking.

3. *Olyphant Washer Test.* In this test, a ⅛ inch thick washer-like specimen is potted in a small aluminum dish (figure 3). Several milled projections provide sharp corners for compressive cracking. The hole in the center also provides for tensile cracking. It is a good test as cracking is immediately visible.

Very few epoxy resin formulations will pass the Olyphant washer test when conducted for 10 cycles from 130°C to —55°C. Most rigid, cured epoxies (whether amine or anhydride cured) will fail in this test. Such compounds will also crack on motors, often merely in the process of cooling the motor from an oven cure to room temperature. Several semi-rigid compounds were found to pass the washer type thermal shock test, but failed in flooded motor tests, in ice-locked rotor tests, or in AIEE motorette aging tests. The final design compound, #293, passed the washer test when conducted from 150°C to —75°C. It also passed the flooded motor test (figure 4), ice-locked rotor test (figure 5), and the various motorette tests. It was thus concluded that very, very severe conditions are required on small laboratory test specimens if the results are to correlate with the results obtained on large items of equipment operating under severe field conditions.

The hardness of the final design compound, as well as its thermal expansion characteristics versus temperature are shown in figures 6 and 7.

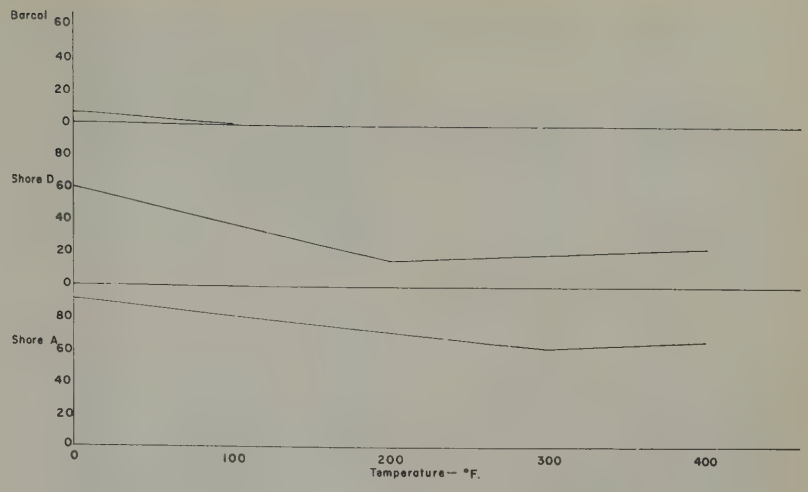


Figure 6, hardness vs temperature for epoxy encapsulating resin.

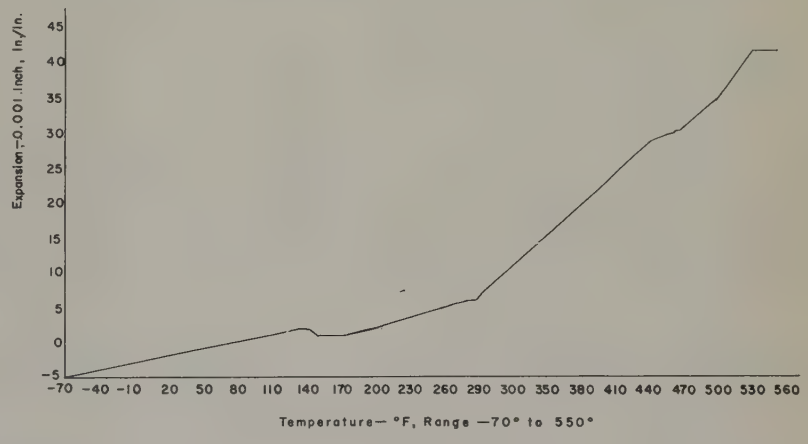


Figure 7, thermal expansion of semi-rigid epoxy resin over wide temperature range.

Important Physical-Chemical Properties Are Noted

Numerous physical-chemical properties were deemed important. These properties are shown in table II.

Good heat stability is required of insulation on a motor operating at 105°C and 130°C (class A & B). Hence, low weight loss at 180°C (class H) and 220°C (class C) were designated for the compound as an accelerated test. The values achieved for the semi-rigid compound, as shown in figure 8, are much lower than those obtained with numerous rigid epoxy resins.

In addition to weight loss, maintenance of overall good properties with extended aging is important. One indication is hardness. Figures 9, 10, and 11 show the excellent retention of initial hardness of the final compound at 100°F, 200°F, and 365°F, despite aging at 365°F (180°C). Very few epoxy resins reveal such minimal change in hardness.

The moisture and chemical resistance of a semi-rigid epoxy is necessarily lower than that of most rigids because the increased chain lengths

Table II

Property	Method	Targeted Design Values	Compound #293
Heat Stability	—	Low weight loss at 108 C and 220 C. Minimum change in hardness with time.	See Fig. 8, 9, 10, & 11.
Water Resistance	—	Low weight gain in boiling water	4.3% weight gain. 3 weeks boiling water
Moisture Vapor Permeability	MIL-I-16923	20×10^{-6} gm/hr/cm	15×10^{-6} gm/hr/cm
Chemical Resistance	—	Good	See Fig. 12
Thermal Conductivity	MIL-I-16923	0.2 Btu/sq. ft/ hr/F/ft.	0.4 Btu/sq. ft/ hr/F/ft.
Flammability	MIL-I-16923	Slow burning	Slow burning
Fungus Resistance	MIL-V-173A	Resistant	Resistant
Magnet Wire Compatibility	AIEE 57	Compatible with common wires	Compatible with common wires

Table III

Property	Test Method	Targeted Design Values	Compound #293
Volume Resistivity	MIL-I-16923	Shall have a volume resistivity exceeding 1×10^8 ohm-cm at 300 F.	See Fig. 15
Dielectric Constant	MIL-I-16923	Snall be 4.5 max. at 1000 cps (1 kilocycle/sec) at 77 F.	OK
Dissipation Factor	MIL-I-16923	Shall be 0.020 max. at 1000 cps (1 kilocycle) at 77 F.	OK
Arc Resistance	MIL-I-16923	Shall be 20 second minimum	125 sec.

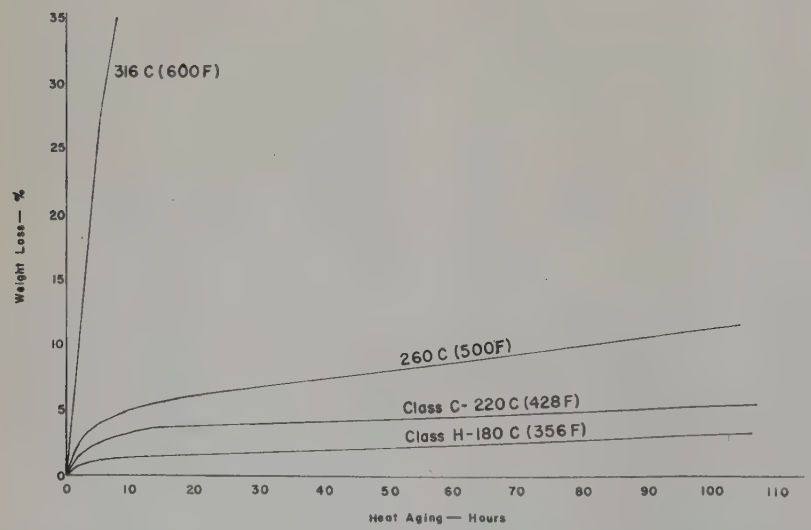


Figure 8, weight loss vs time at various temperatures for semi-rigid epoxy resin.

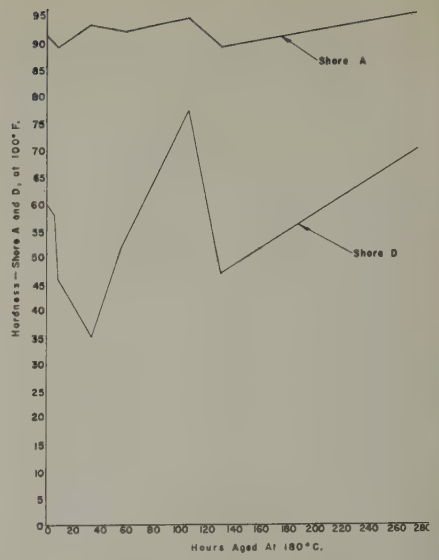


Figure 9, hardness at 100°F vs time at 356°F for semi-rigid epoxy resin.

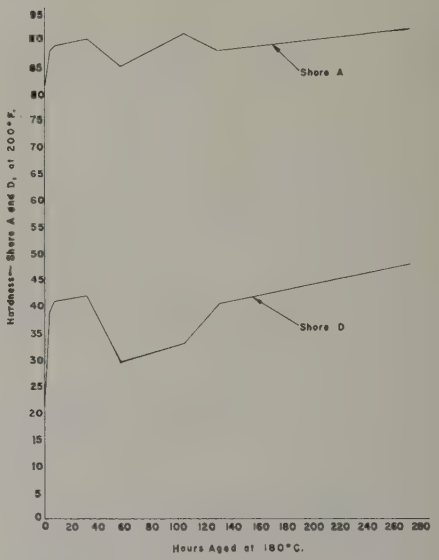


Figure 10, hardness at 200°F vs time at 356°F for semi-rigid epoxy resin.

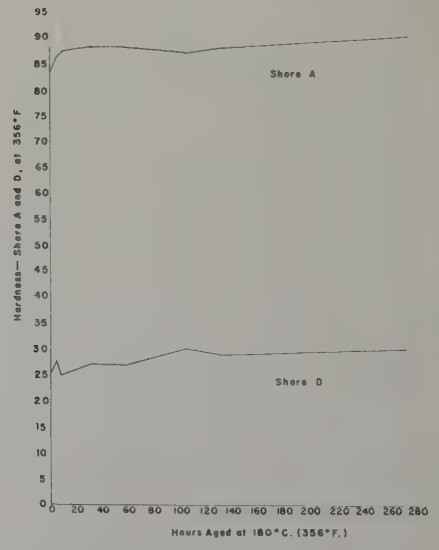


Figure 11, hardness at 356°F vs time at 356°F for semi-rigid epoxy resin.

and wider atomic spacing provide more entrance points for attack at the molecular level. However, tests determined that the design compound had adequate moisture resistance, water vapor transmission rates, oxidation resistance (figure 12), and caustic resistance for field service (figure 13). The resistance to highly polar or chlorinated solvents (acetone or trichloroethylene) was adequate for field use except in cases of complete immersion in fluorinated refrigerants. This is particularly true when it is considered that such solvents are also fast evaporators and there is almost no possible combination of circumstances wherein such materials could be expected to inundate a motor and not immediately evaporate, thereby having insufficient dwell time to even begin to penetrate the epoxy insulation wall.

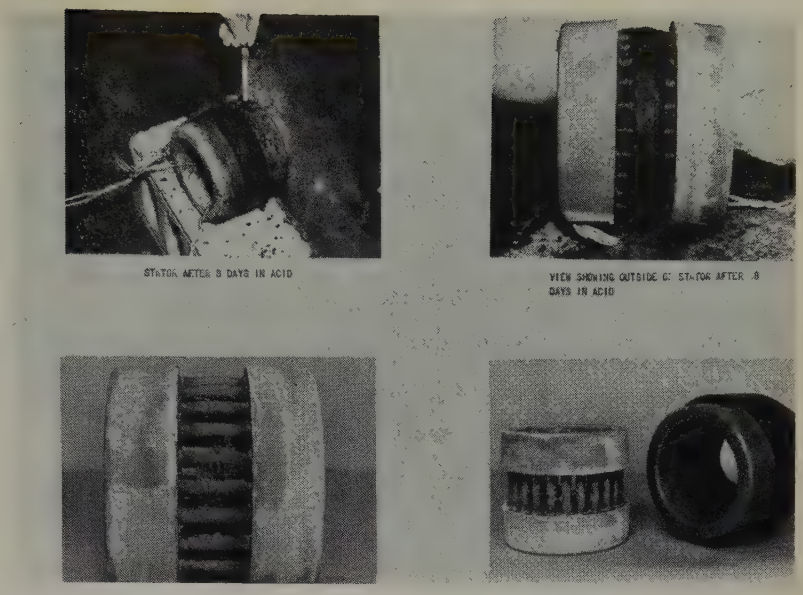


Figure 12, encapsulated stator exposed to nitric acid to show permanency of windings. Lower two illustrations show components after 23 days in acid.

Epoxy Encapsulation Aids Heat Transmission

Thermal conductivity is also an important property. The epoxy resin encapsulation eliminates dead air pockets in the slots of a motor and within the knuckles of the coils and thus speeds the transmission of heat generated in the copper out to the iron stator and out to the air stream. The thickness of insulation on the end of the coils does offset these advantages to the extent that the stator usually operates at a normal temperature rise or slightly above. In some cases the stator will run cooler.

In addition, the temperatures within the motor tend to be more uniform than in a standard open-type motor, which must allow for a 15°C temperature difference between the average winding temperature and the hottest-spot. Thus, since the temperatures in the encapsulated motor are uniform there is a growing tendency to permit the design of an encapsulated motor to utilize this 15°C as an increase in average temperature, just as is done in the case of the totally-enclosed fan-cooled motor. However, development of an epoxy compound with a thermal conductivity approximately four times greater than that of a rigid, unmodified epoxy resin has provided generally satisfactory heat run results in designs to date. For example, on a 7½ hp, 4 pole-motor, the temperature decreased by 5 percent over a standard open motor, while on a 10 hp, 4 pole motor the winding temperature increased by 10 percent, indicating that temperatures of encapsulated motors range close to those of varnished motors.

No amount of encapsulation can guard a motor against single phasing and locked rotor conditions. Therefore, encapsulated motors do burn out and have to be rewound. By designing for a slow burning compound, there is adequate assurance that the insulation will not burn on the motor, but on the other hand, the encapsulant can be burned off in a burn-out oven without the presence of the obnoxious and toxic fumes associated with chlorine-containing compounds usually required to make a resin flame-resistant.

Fungus resistance is important in the Gulf states and the tropics. As a rule of thumb, materials which are completely synthetic and whose molecular structure does not resemble any molecule found in nature, and do not contain any of the oils, waxes, acids, resins, or diluents often used to formulate resin compounds, will be non-nutrient to fungi. This was found to be the case for #293, when tested with aspergillus terreus, fusarium moniliforme, aspergillus niger, chaetomium globosum, and penicillium luteum.

Magnet wire compatibility is a property of extreme importance. There is no benefit in keeping moisture and contaminants out of the windings if the epoxy resin is going to chemically attack or degrade the magnet wire insulation film. Much research has been done on this aspect (Ref. 3), and more work is underway. In general, however, it has been found possible to formulate in such a manner that the wire is not attacked but is actually reinforced. It is quite feasible to mechanically and chemically reinforce poly (vinyl formal) -phenolic cross-linked wire so that instead of a class A (105°C) life it reveals a class B (130°C) life (figure 14).

Resin's Volume Resistivity Is Main Electrical Property

Electrical properties are of concern in areas where the magnet wire film may be damaged or defective. Hence, the epoxy encapsulating resin should have good volume resistivity. The other common electrical properties should have insulating material values, but are less critical. The parameters selected are shown in table III. The volume resistivity versus temperature for a number of typical insulating resins are shown in figure 15.

For commercial purposes, the best theoretical resin is of no use if the equipment and processes for handling

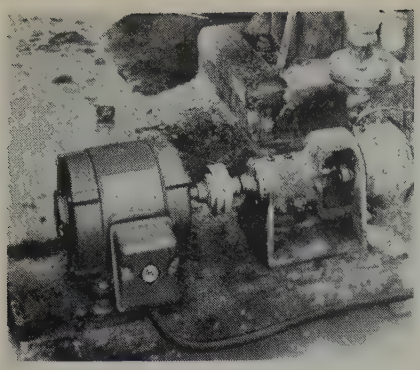


Figure 13, encapsulated motor in citrus plant exposed to citric acids and caustic washdown waters.

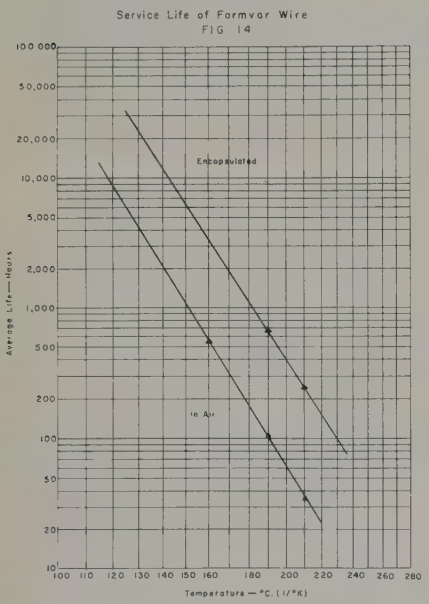


Figure 14, service life of "Formvar" wire.

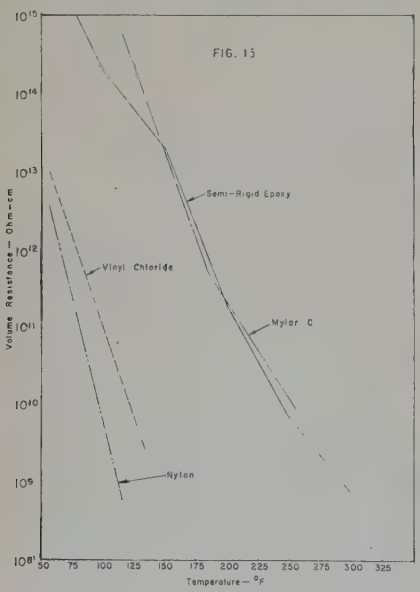


Figure 15, volume resistivity of semi-rigid epoxy and several other insulations.

it are unrealistic from a production standpoint. The close adjustment and control of handling properties of a resin are critical elements in the economical production of encapsulated motors, and call for an immense amount of attention to detail on the part of the compound supplier and the motor production departments. Properties of concern are: (1) mixing ratio, (2) color of unmixed and mixed components, (3) viscosity of unmixed and mixed components, (4) optimum working temperatures, (5) wetting action of compound, (6) viscosity versus time at a given temperature after mixing, (7) gel time, (8) cure rate after gel (9) exotherm, (10) color and gloss of cured material, and (11) release agent considerations.

How these properties have a bearing on the encapsulated unit is perhaps obvious. Low viscosities and wetting action are essential to good fill and penetration (figure 16). Fast gel (after air has had time to be removed by vacuum or heat) and rapid development of hot hardness are essential to fast mold recycling. Controlled exotherm is essential to low shrinkage, nonfoaming and no attack on heat sensitive magnet wire films.

Conclusion

The attainment of these various properties in a low-cost epoxy resin formulation has permitted the introduction of the first commercial encapsulated motor, and the first chemical-resistant or flood-resistant open motor, at only nominal added cost. Industry's rapid acceptance of this new motor is mute testimony to the advantages of thorough epoxy-engineering.

Acknowledgments

The authors wish to acknowledge the help and assistance of Vernon B. Honsinger and Henry T. Murdock of Allis-Chalmers Manufacturing Co. in the preparation of this article.

References

1. H. Lee and K. Neville, "Epoxy Resins, Their Technology and Applications," McGraw-Hill Book Co., New York, 1957.
2. C. Hackney and H. Walker, "Insulation System for Naval Shipboard Motors Intermittently Submersed," AIEE Transactions 60-858, 1960.
3. H. Lee, "Compatibility of Magnet Wire Insulations and Epoxy Encapsulating Resin," National Conference on the Application of Electrical Insulation, Washington, D.C., 1959.

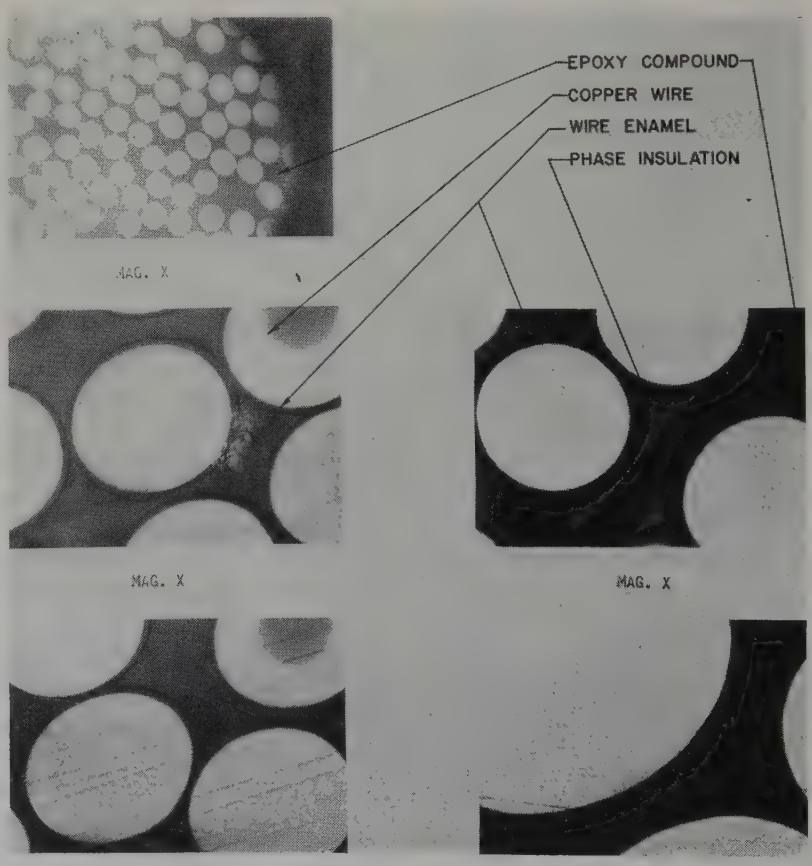


Figure 16, magnifications of epoxy encapsulated motor windings show complete and thorough fill.

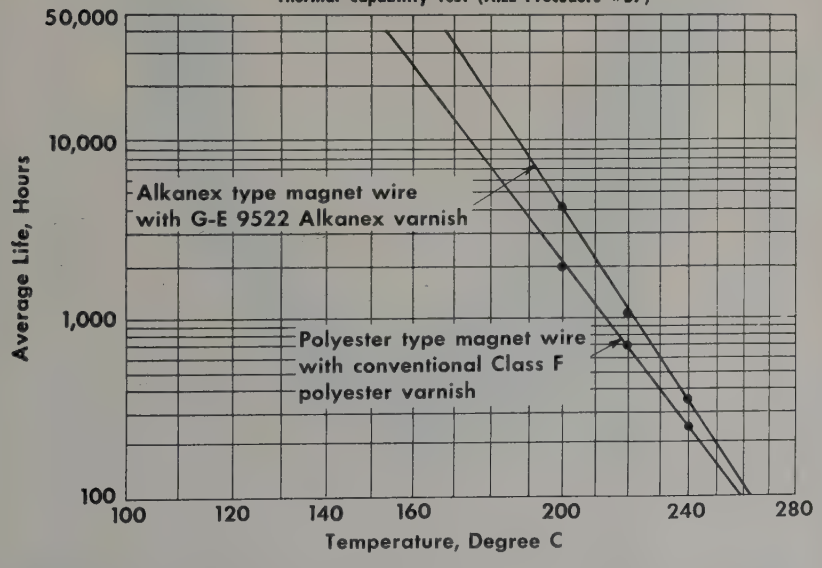
New General Electric

CLASS F ALKANEX INSULATING VARNISH

Alkanex® 9522—General Electric's new all-purpose insulating varnish—represents an important insulation breakthrough in Class F materials.

Performance-proved by laboratory tests at G-E's Insulation Application Center, Alkanex 9522 far exceeds Class F requirements—operates near Class H temperatures, but at less cost. OUTSTANDING HEAT LIFE of this new G-E varnish is demonstrated by tests showing satisfactory operation after 40,000 hours at 168 C! At the same temperature, conventional Class F polyester varnish fails after only 15,000 hours.

FOR ADDITIONAL INFORMATION ON ALKANEX 9522—or any of the quality G-E Class F materials—contact your Authorized G-E Insulating Materials Distributor, or write Section 108, Insulating Materials Dept., Schenectady 6, N. Y. 845-11

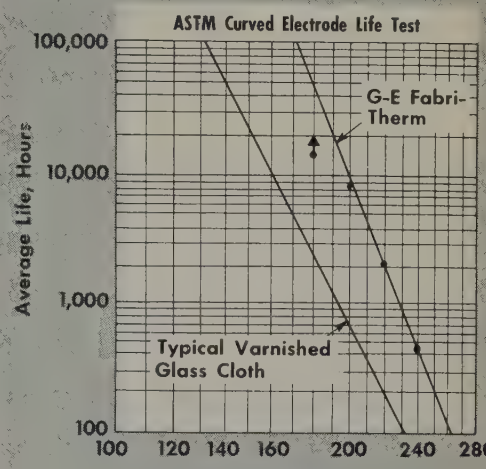


ALKANEX TYPE MAGNET WIRE treated with G-E 9522 Alkanex varnish outperforms other polyester wire with polyester varnish at Class F temperatures, as proved by results of this thermal capability test conducted according to AIEE #57 Test Procedure.

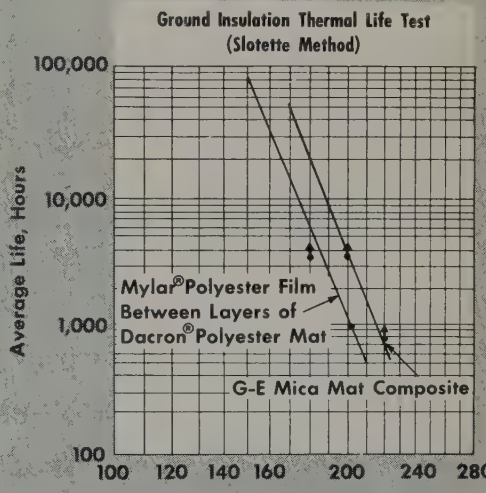
GENERAL ELECTRIC

Print Ins. 13 on Reader Service Card

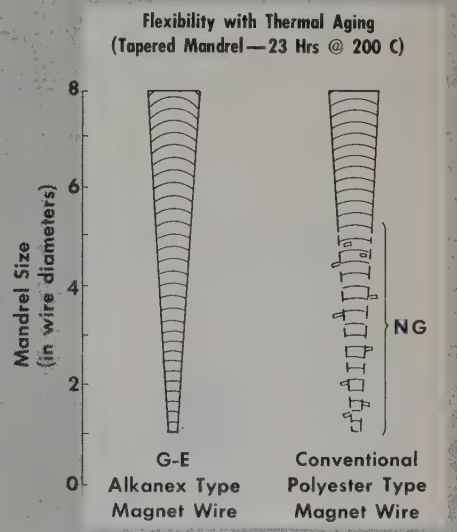
TESTS PROVE RELIABILITY OF THESE OTHER G-E CLASS F MATERIALS



G-E FABRI-THERM for phase and layer insulation extrapolates at 180 C for 40,000 hours, has logged 15,000 actual hours to date at 180 C with excellent results.



G-E MICA MAT COMPOSITE—for ground insulation—has a thermal life in excess of 40,000 hours at 172 C as shown by the slotette test method.



MAGNET WIRE ENAMELED WITH G-E ALKANEX, available from leading magnet wire manufacturers, gives excellent flexibility after 23 hours at 200 C . . . no cracking or peeling at 1X; other polyester magnet wire tested shows significant cracking at 5X.

Simple only in appearance,
this forward insulating ring supplies the high mechanical and electrical properties for a critical naval ordnance application. Fabricated by CDF from glass fabric epoxy tube, this ring illustrates an effective combination of material properties and manufacturing techniques.
Result: an insulating component with high strength-to-weight ratio, low water absorption, low thermal conductivity, inherent fungus resistance, and high dimensional stability.

CDF **CONTINENTAL-DIAMOND FIBRE**

CONTINENTAL-DIAMOND FIBRE CORPORATION, NEWARK, DELAWARE • A SUBSIDIARY OF THE Budd COMPANY

Deformation—Recovery Characteristics Of A Styrene UHF Insulation Under Load, Time, and Temperature

By Howard E. Pendergast, Manager of Research and Development, and James D. Kelly, Product Manager of Dielectric Materials, William Brand-Rex Div., American Enka Corp., Concord, Mass.

A crosslinked styrene copolymer with high radiation resistance and exceptional electrical properties at ultra high frequencies was recently examined for its deformation characteristics under loads from 10 psi to 2000 psi at 20°C to 200°C.

This thermosetting plastic did not exhibit permanent plastic flow in the range of conditions investigated and no permanent deformation occurred. The behavior of the material may be characterized by an ordinary modulus of elasticity of 4×10^5 psi and by a time-dependent modulus of high elasticity of 1000 psi. The time to obtain equilibrium deformation varies in a logarithmic fashion with temperature and falls from a value of 10^9 minutes at 70°C to less than one minute at 150°C. This mechanical behavior can be described mathematically in terms of physical constants for the plastic.

The plastic, "Rexolite" 1422, is produced in rod or sheet form by the Rex Corp., West Acton, Mass. A description of the method of testing and of the actual results follows.

Preparation of Test Specimens

The material used was in the form of a cast transparent plate approximately ½-inch thick and 6 inches square. The plate was cut into slightly oversized cubes by saw and annealed at 120°C for 15 hours, followed by very slow cooling to thoroughly relieve all casting strains. The samples were then very accurately machined to ½-inch cubes. Each completed test specimen was exposed to the desired temperature for 3 hours before loading to insure thermal equilibrium.

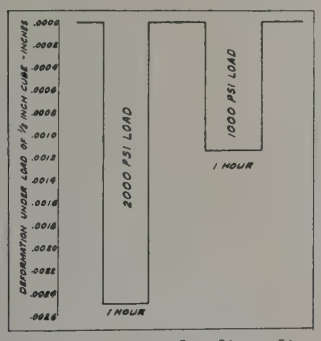


Figure 1, time loading diagram illustrating elastic deformation and recovery at 20°C.

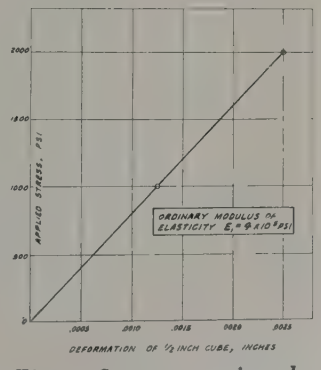


Figure 2, stress-strain relationship at room temperature.

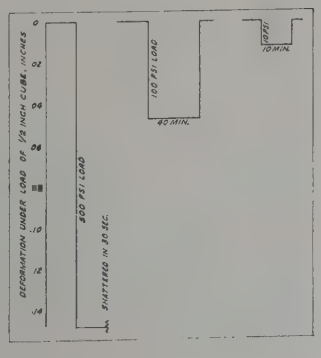


Figure 3, time loading diagram illustrating elastic deformation and recovery at 150°C. At 200°C the deflection and recovery were identical for 100 psi and 10 psi.

Test Equipment

Deformations under compressive loads for stresses of 100 psi to 2000 psi were measured in equipment satisfying the requirements of the high-pressure testing machine of ASTM designation D621-51, method A. Measurements under stresses of 10 psi to 100 psi were made on equipment in accordance with the requirements of the low pressure deformation tester of ASTM designation D621-51, method B.

The test chambers used to enclose the testing apparatus were forced-draft ovens of low power input to heating units with a maximum temperature fluctuation of 4°C. The temperature around the test specimens while in the testing apparatus was controlled to within minus 3°C plus 1°C of the desired test temperature. Temperature measurements were made with total immersion thermometers readable to ±0.2°C. The thermometers were suspended in such a manner that the bulbs were on the same level as the specimen under test and within 3 inches of the specimen.

Distortion measurements were made by dial gauges with 0.001-inch subdivisions and a readability of ±0.0001 inch. Sensitive mircometers were used to check recovery.

Ordinary Modulus of Elasticity

Figure 1 shows a time loading chart for the material at room temperature. It can be seen that the plastic behaves like an elastic solid. When loaded, the test cube deformed to a constant value; and when unloaded, it immediately recovered to its original height. Moreover, when half the initial load is applied, the cube attains half the deformation. Figure 2 shows a stress-strain curve for this test. In this low range of deformation the usual linear relation is obtained. The ordinary modulus of elasticity, E_1, is calculated from the slope of this curve to be 400,000 psi.

Modulus of High Elasticity

Figure 3 illustrates tests carried out at 150°C. Again,

this plastic behaves like an elastic solid. When loaded, the test cube deformed to a constant value. When unloaded, it immediately recovered its original height. Moreover, the deformation under load has a definite relation to the load. The deformations under each load were identical at 150°C and 200°C.

The data of this series of tests are plotted in a stress-strain curve shown in figure 4. This material is extremely elastic at these temperatures. The cube may be easily deformed 25 percent of its height. As the ordinary elastic deformation at 1000 psi, given by the ordinary modulus of elasticity, is slightly more than .001 inch and the high elastic deformation under 1000 psi is over .200 inch, the ordinary elastic deformation may be neglected. The stress-strain relation is not linear but of exponential shape. This curvature arises from the very great deformations involved. As the cube is compressed, its volume does not noticeably change, hence its cross-section increases as the height decreases. The sides of the cube attain a marked bulge.

This action increases the load-bearing area of the specimen, and the actual deforming stress is considerably less than the initial applied stress. It is likely that the resulting deformation is still proportional to the actual stress, which is lower than the applied stress due to geometric changes caused by great deformation. However, the very low values of deformation are proportional to the applied stress, and the high elastic modulus of elasticity, E_2, is calculated from the initial slope of this curve. This modulus is 1000 psi. Thus, at these temperatures the behavior of this plastic resembles the mechanical behavior of rubber at room temperature.

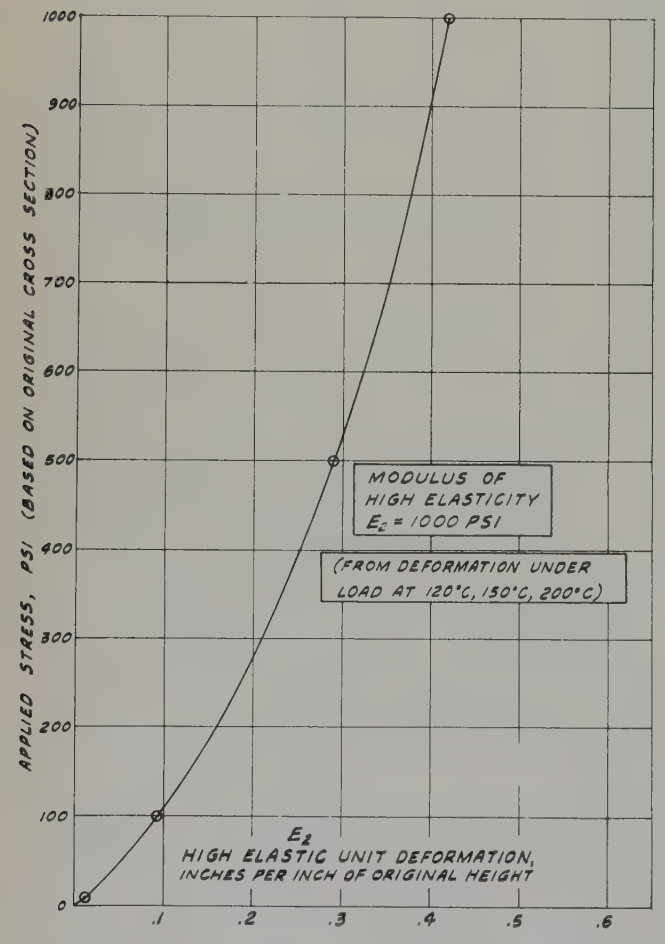


Figure 4, stress-strain relationship at high temperature.

Deformation-Time Curves

Up to this point, the plastic has displayed simple properties at high temperatures and at low temperatures with an ordinary modulus of elasticity of 4×10^5 psi characterizing the low temperature behavior and a high elastic modulus of elasticity of 1000 psi characterizing its high-temperature behavior.

If the low temperature is raised to 90°C or the high temperature test is lowered to 125°C, a different behavior

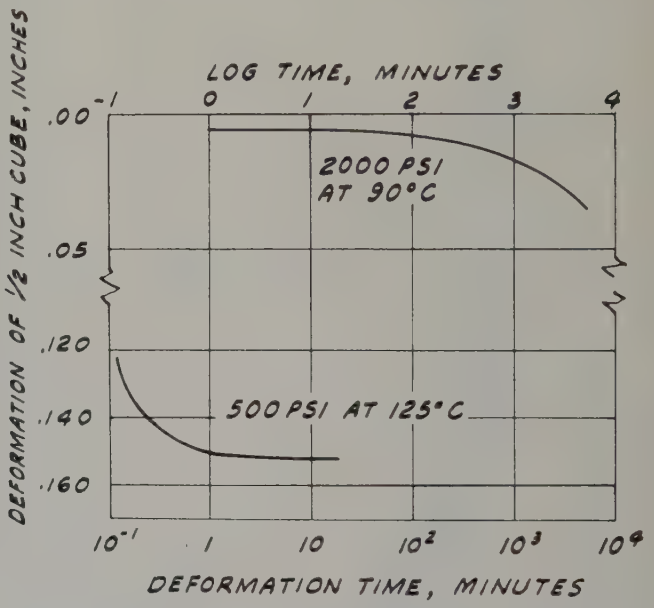


Figure 5, time-dependent deformation at temperatures lower than 150°C and higher than room temperature.

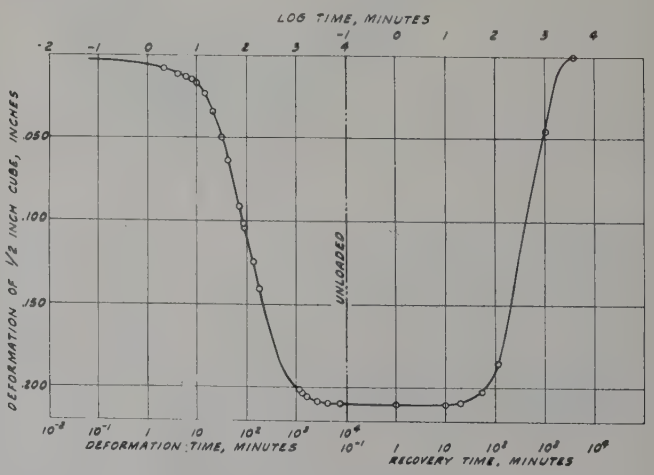


Figure 6, deformation-time relationship at 1000 psi and 105°C.

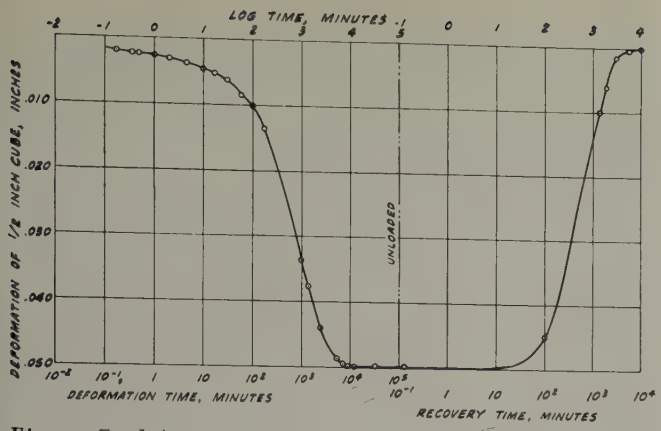


Figure 7, deformation-time relationship at 100 psi and 105°C.

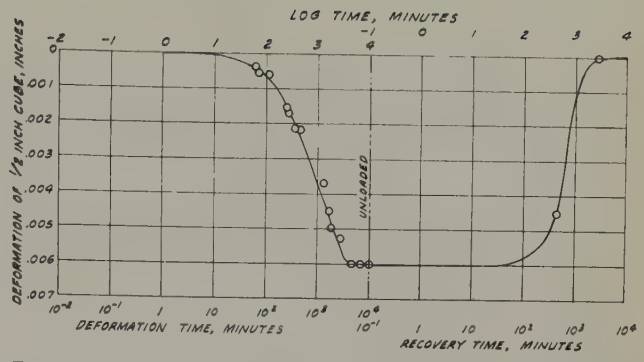


Figure 8, deformation-time relationship at 10 psi and 105°C.

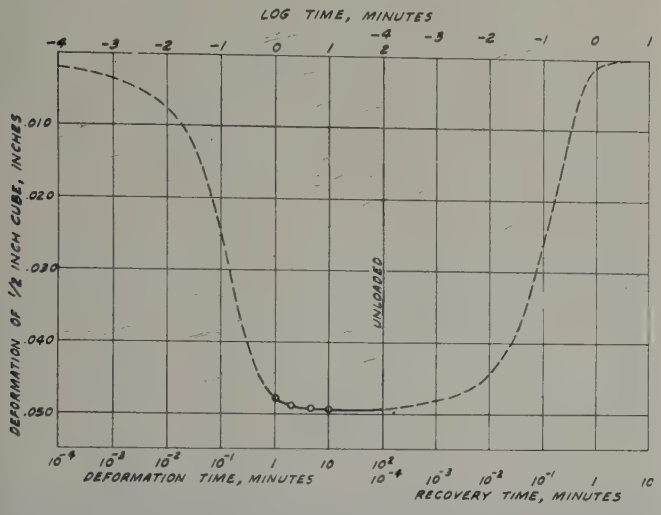


Figure 9, deformation-time relationship at 100 psi and 125°C.

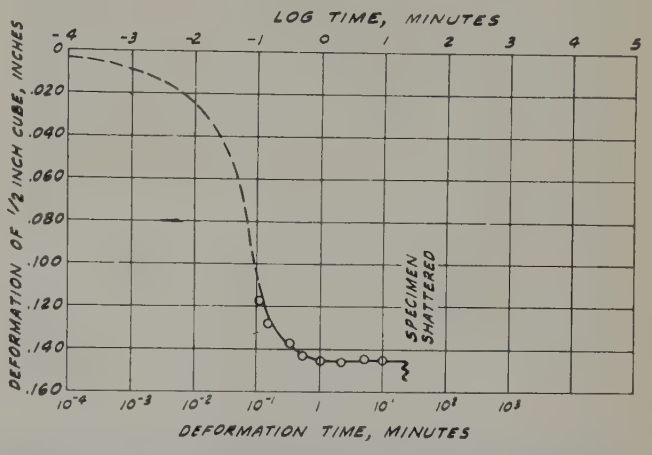


Figure 10, deformation-time relationship at 500 psi and 125°C.

under load is immediately noted. Data for such tests are shown in figure 5. At 90°C a pronounced continuing creep is noted up to 10,000 minutes with no indication of a limiting value. At 125°C an apparent creep under load is also noted. However, an equilibrium deflection is quite rapidly obtained, and no further deformation takes place.

Reference to figure 4 will show that this limiting deflection at 125°C is that resulting from the modulus of high elasticity obtained at 150°C and 200°C and subsequently shown to be independent of temperature. Examination of figure 5 will show that the curve at 90°C is very roughly the inverted mirror image of the curve at 125°C. This leads to the thought that the 90°C data represents the first portion of a time-deformation relationship and the data at 125°C represents the final portion of a time-deformation relationship. Thus, some intermediate temperature should give the intermediate time-deformation relationship.

A test at the intermediate temperature of 105°C at 1000 psi is shown in figure 6. It is seen at once that the time-deformation curve is obtained from a rather small deformation to the equilibrium value. Moreover, when the test cube is unloaded, full recovery to the original height is obtained. In addition, reference to figure 4 will show that, again, the equilibrium deformation is given by the high elastic stress-strain curve. The time to obtain equilibrium deformation is approximately equal to the time for full recovery after removal of load. No plastic or unrecoverable deformation occurs, and the material is characterized by a delayed elasticity.

Figures 7 and 8 illustrate the time-deformation curve at 105°C under 100 psi and 10 psi, respectively. Again, the limiting deflection is that given by figure 4. The times for equilibrium deformation are all just about the same for all loads and the deformation at any time after loading is related to the load as given in figure 4. Therefore the time-deformation curve for any load may be obtained from the load-deformation relation of figure 4 and the deformation-time relation of figure 7.

All of these curves, when calculated to unit stress give the same time-deformation curve within the accuracy of the individual test. The recovery curves on unloading are of the same character, but the low deformations recover in slightly less time than the high deformations. This might be expected: when a highly loaded sample has recovered, on unloading, to the deformation of a newly unloaded sample with low deformation, the internal recovery forces are probably about the same. The actual differences in recovery time are masked to some extent by the logarithmic abscissa which emphasizes the initial recovery time so that the initial minute of recovery has the same weight as the last 9000 minutes.

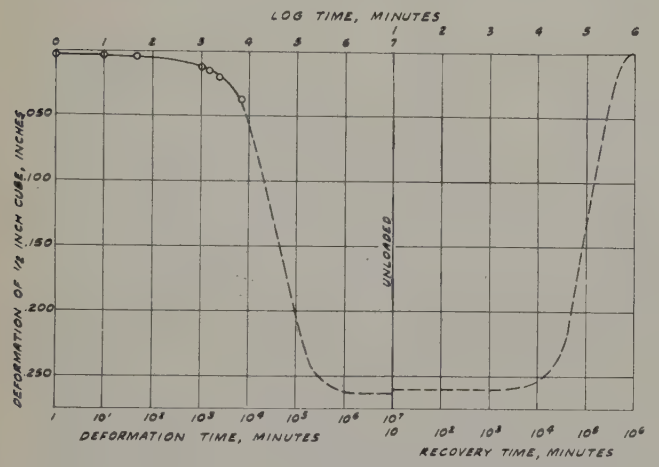
Time Shift of Deformation Curves

There is a very good reason for plotting these curves of deformation as a function of the logarithm of time. As the delayed elasticity is characterized by a curve extending over at least six orders of time, a linear time chart would give little information as practically no change occurs during the major portion of the time. In addition, it can be safely assumed that the delayed elasticity is caused by a viscosity effect in part of the plastic. It is well known that, in general, the logarithm of viscosity is a fairly linear function of temperature. Thus, a shift of the logarithmic time scale of these curves is approximately equal to a change in temperature, and the curves should all be about the same under the same load at various temperatures but displaced from each other along the time axis.

Figures 9 and 10 show the data for deformation under 100 psi and 500 psi, respectively, at 125°C. The solid part of the curves represents the laboratory data. Due to physical limitations, it was impossible to obtain values for deformation at times less than about .1 minute. When the curve of figure 9 at 125°C is superimposed on figure 7, a very good match is secured by shifting the 105°C curve of the figure 7 back about 3½ orders of time. This procedure allows the complete curve at 125°C to be traced in. It is noticed that the observed data fit very well and that the initial deformation and recovery occur in an extremely short time and cannot be measured by ordinary means.

In the same manner, the full curve at 90°C may be obtained as shown in figure 11 by shifting the curve of figure 6 for 1000 psi at 105°C calculated for the higher 2000 psi stress forward about 2½ orders of time. As can be seen, a very good fit is obtained. It is very important to notice that the probable course of a time-deformation curve is obtained from data of a one-week test which would require a test of about 20 years to obtain experimentally and another 20 years to obtain recovery.

Figure 12 shows the long-time creep curves at 90°C, 70°C, and 20°C under 2000 psi. It has been shown that the 105°C curve can be shifted forward 2½ orders of time to match the 90°C curve. It will be noticed in figure 12 that at any deformation the curves at 90°C and 70°C differ by 2⅛ orders of time and that the 90°C curve, when



Figue 11, deformation-time relationship at 2000 psi and 90°C.

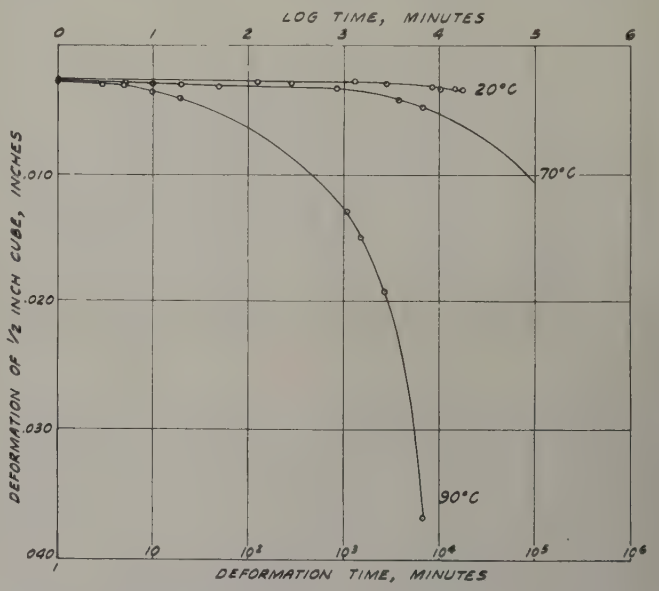


Figure 12, deformation-time relationship at 2000 psi and various temperatures.

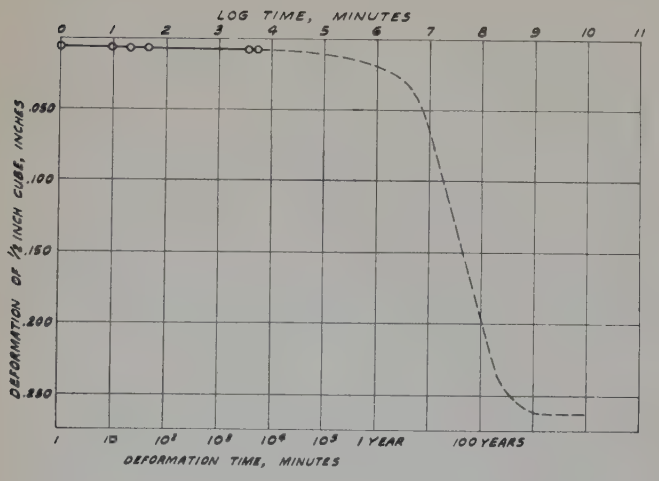


Figure 13, deformation-time relationship at 2000 psi and 70°C.

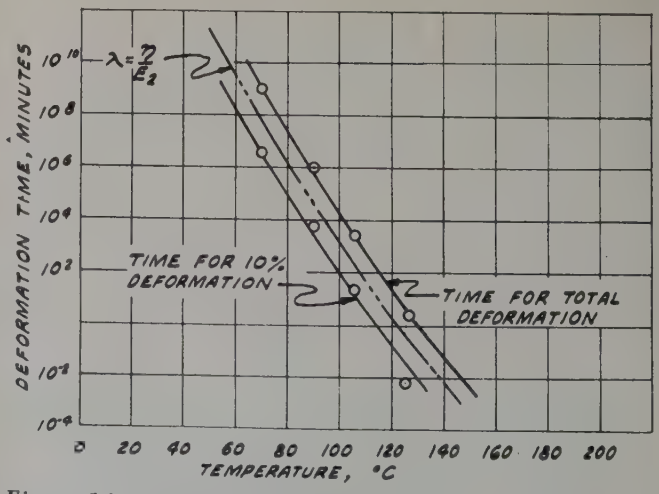


Figure 14, retardation time and temperature relationship for the high elastic deformation.

shifted forward, matches the 70°C curve perfectly. Thus, the complete 70°C deformation curve is shown in figure 13, obtained by shifting the curve of figure 11 at 90°C forward along the time axis as indicated in figure 12.

A curve covering 1000 years has been obtained from one week's data. The curve represents at least the correct order of magnitude of the time-deformation curve. The validity of such a double extrapolation is unimportant, as no one actually cares what happens after only a portion of such time. Other environmental and fatigue factors would be much more important if the test piece were not lost. However, practically, such a curve will accurately portray deformation behavior during a normal useful life and indicate the continuing creep and its probable magnitude.

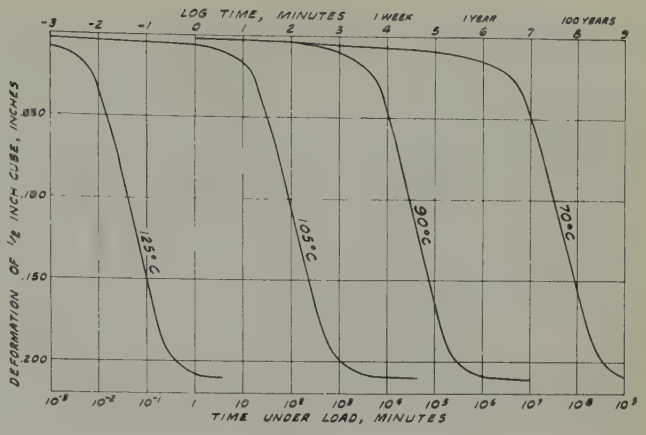


Figure 15, deformation-time relationship at 1000 psi and various temperatures.

Retardation Time-Temperature

The time to obtain 99 percent and the time to obtain 10 percent of the equilibrium deformation at each temperature is obtained from figures 5 to 13, and its logarithm is plotted as a function of temperature in figure 14. The accuracy of the data is reflected by the linear relation, which is characteristic of a logarithm of viscosity-temperature relation. Correctly, such a curve should be expressed as a function of the reciprocal of the absolute temperature. However, over this limited range no great difference would be noted.

Summary of Deformation Curves

The individual time-deformation curves at each temperature were proportioned by means of figure 4 to 1000 psi applied stress and are shown in figure 15. This set of curves well characterizes the complete range of deformation-time-temperature behavior of the material. Reference to the time for deformation-temperature curve of figure 14 will enable one to place the time-deformation curve on figure 15 at any desired temperature. Reference to the stress-deformation curve of figure 4 will allow this relation to be corrected to any desired stress. Hence, it is possible by means of these three curves to obtain the deformation characteristics at any desired temperature, stress, and time and thus completely characterize the behavior of this plastic under load.

New RCI Epoxy Casts Under Vacuum Without Foam-out

Typical casting made with ordinary low-viscosity epoxy containing volatile diluents that foam out at room temperature under vacuum.

This coil was impregnated with RCI EPOTUF 37-129 under a full vacuum of 29.5 inches of mercury. Note absence of bubbles, smoothness of surface.

RCI EPOTUF 37-129 is a non-volatile, 100% reactive liquid epoxy resin with a viscosity below 1,000 cps and a boiling point over 150° C. at 5 *mm* Hg absolute pressure.

EPOTUF 37-129 was specifically engineered for electrical use—it can be cast under high vacuum to assure complete impregnation of coils or motor windings without foam-out due to diluent boil-off. In addition, the cured resin achieves superior electrical properties and improved moisture resistance.

Write today for further details about EPOTUF 37-129.

RCI

CREATIVE CHEMISTRY...YOUR PARTNER IN PROGRESS

REICHHOLD

Synthetic Resins • Chemical Colors • Industrial Adhesives • Phenol
Hydrochloric Acid • Formaldehyde • Phthalic Anhydride
Maleic Anhydride • Ortho-Phenylphenol • Sodium Sulfite
Pentaerythritol • Pentachlorophenol • Sodium Pentachlorophenate
Sulfuric Acid • Methanol

REICHHOLD CHEMICALS, INC.,
RCI BUILDING, WHITE PLAINS, N.Y.

Print Ins. 15 on Reader Service Card

Aging Characteristics of Film Insulated Copper Wire in Transformer Oil

By G. F. Lipsey and P. W. Juneau Jr., General Electric Co., Pittsfield, Mass.

Economic as well as manufacturing advantages have led to the replacement of paper and cotton conductor insulation by film insulated wire in liquid filled apparatus, particularly in the distribution and small power transformer lines. These factors have prompted an investigation of many different types of wire enamels in order to determine the most suitable material for use in transformers.

Small round wires such as those found in the high voltage windings of distribution transformers have been insulated with a variety of different enamels, such as oleoresinous types, alkyd phenolics, polyester polyamides, modified epoxies, and phenolic modified polyvinyl formal. Within recent years many new enamels have appeared on the market, each accompanied by impressive claims with regard to thermal endurance, chemical resistance, and mechanical properties, with most of the data being obtained by techniques applicable to end use in air cooled apparatus. Much of the data obtained, such as initial mechanical and physical properties, eg., scrape abrasion, flexibility, snap, etc., is applicable regardless of whether the enameled wire is used in air or is liquid immersed. Aging data obtained in air, however, is not always amenable to interpretation for use in liquid filled apparatus.

When a film insulation is aged in air, the material is subject not only to degradation by virtue of extreme temperatures, but also to the attack of atmospheric oxygen. Under these conditions, the more oxidation stable materials will always appear in a more favorable light. However, this type of evaluation neglects the effect of the insulation environment encountered in a sealed liquid filled apparatus which has a deleterious effect on the thermal stability of some polymers. The deleterious effect in this instance is brought about by the decomposition products, such as water and acid, of the insulations and dielectric liquid. Previous investigators have also determined that the weight loss of certain polymeric films was much less when aged in a sealed tube containing air, than when aged at the same temperature for comparable periods of time in a high velocity air oven.[1]

In order to better assess the relative merits of the various wire enamels for such use, work was initiated to study the aging characteristics of film insulated round wire in environments similar to those found in sealed liquid filled transformers.

Thermal Evaluation Procedure

All studies were based on accelerated aging principles wherein the samples were aged at temperatures much higher than normal. Deterioration of dielectric strength was used as the means of evaluating the aging characteristics of the enameled wire.

Description of Samples and Aging Containers

The wire samples were standard twisted wire pairs[2] made with .0508″ diameter round copper wire coated to a nominal 4-mil build (4-mil dia. increase) with the enamel to be studied.

The aging containers were ordinary "Pyrex" test tubes, thoroughly cleaned before use. The size normally used was 25 mm x 300 mm.

Each tube contained six twisted wire pairs coated with the enamel under study, 8 grams of 5-mil water finished Kraft paper (dry weight), and 72 cc (63g) of DBPC inhibited transformer oil. The paper was added to represent the cellulosic insulation in a transformer. Some sample tubes were prepared without paper, in which case 80 cc (72g) of transformer oil were added in order to keep the air/oil volume ratio constant at approximately 15% air.

The aging containers, complete with samples, as shown in figure 1, were dried at 105°C under vacuum at 150 microns for 16 hours, then removed from the drying tank and immediately filled while still hot with deaerated oil. Repeated tests on paper

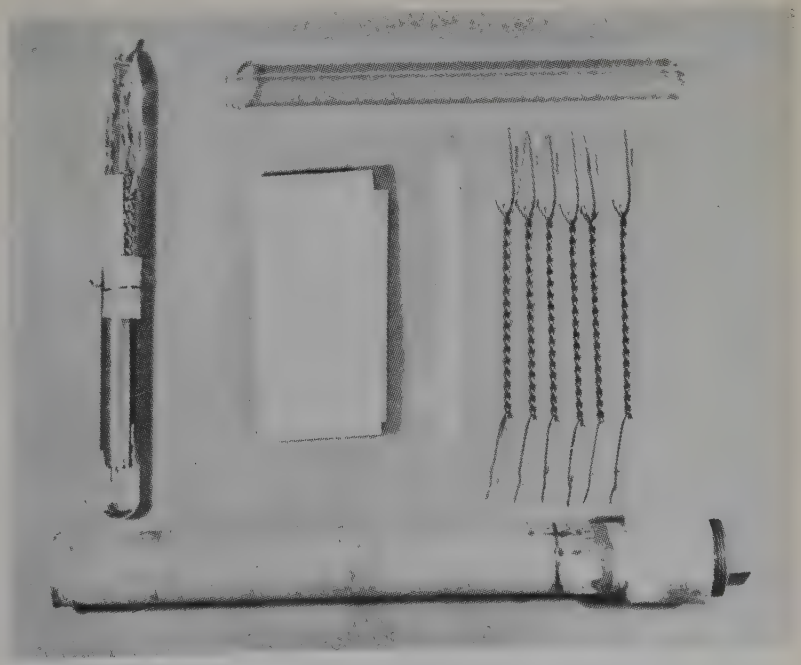


Figure 1, aging container and contents.

dried and oil impregnated under these conditions indicate a moisture content of approximately 0.1%. To illustrate the effect of moisture, known concentrations of water (1%, 3% and 6%, based on dry paper weight) were added to some of the paper containing tubes, while others were left in the dried condition. The tubes were then hermetically sealed, using ordinary glass blowing techniques, placed in safety containers and aged at 100°C, 125°C, 150°C, and 175°C. Some tests were also undertaken at 135°C, 165°C, and 200°C.

Test Procedures

In order to obtain test values more in line with operating conditions and to simulate the normal hot spot condition according to ASA guides[3], dielectric strengths of the aged samples were determined under oil at 105°C. The sample tubes were removed from the aging oven, allowed to cool to room temperature, broken open, the wire samples placed in the 105°C oil and tested as quickly as possible. The 60-cycle test voltage was applied between 30 and 60 seconds after immersion and increased at a rate of 500 volts per second until breakdown occurred.

The influence of moisture on the chemical stability of enameled wire was also determined by heating the enameled wires in a sealed tube with water but no paper present in the oil.[4] Those which were unaffected by such a test were classified as being hydrolytically stable. It was found that the acrylic, urea formaldehyde epoxy, and phenolic modified polyvinyl formal wire enamels were resistant to hydrolysis, while the oleoresinous, terephthalate polyester, polyester polyurethane, polyester epoxy, and polyester polyamide epoxy enamels were hydrolytically unstable. The enamels which are not resistant to hydrolysis usually degrade to a sludge in a very short period of time (1-2 days) leaving the wire bare. In view of the fact that one of the major insulations used in transformers is Kraft paper, which decomposes upon long time aging at relatively moderate temperatures to form significant quantities of water, the resistance of a wire enamel to chemical degradation by the attack of water assumes major importance.

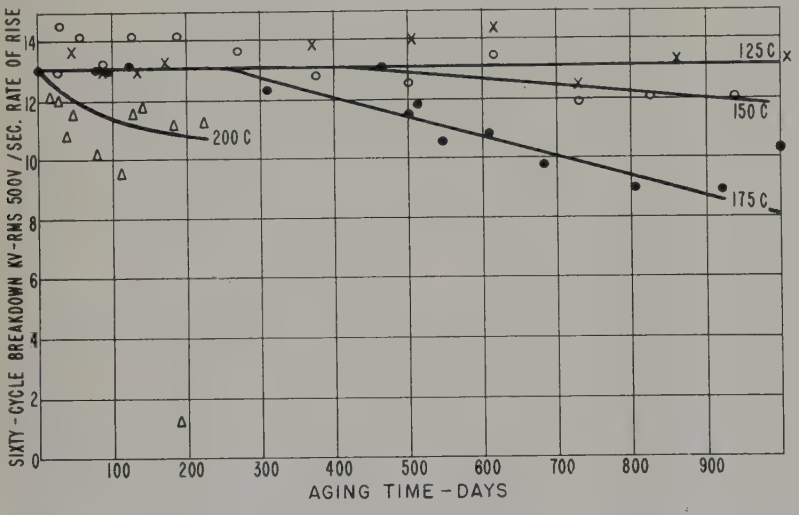


Figure 2, the effect of aging in transformer oil on the dielectric strength of Formex insulated wire. Tests made in 105°C oil.

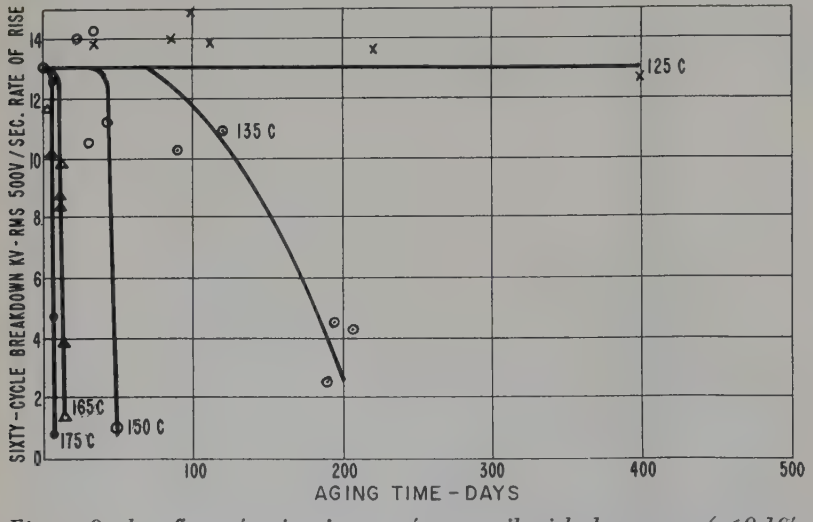


Figure 3, the effect of aging in transformer oil with dry paper (<0.1% H_2O) on the dielectric strength of Formex insulated wire. Tests made in 105°C oil.

Results and Discussion: Formex* Insulated Wire

The initial or zero aging time dielectric strength of the Formex twisted wire pairs under oil at 105°C was found to average 13.2 kv.

The first series of agings of Formex insulated wire in oil alone (i.e. with no paper present) at 125°C, 150°C, and 175°C are shown on figure 2. The effect of aging at 125°C and 150°C is negligible even after 1000 days. At 175°C, approximately 80% of the initial dielectric strength of Formex is maintained through 800 days of aging.

Figure 3 shows the effect of the presence of dry paper (0.1% H_2O by wt) on the dielectric strength of the Formex insulated wire at 125°C, 135°C, 150°C, 165°C, and 175°C. While there is little drop in the dielectric strength in 525 days at 125°C, the dielectric strength is markedly affected at the higher temperatures. If these data are adapted to the Arrhenius reaction rate equation in which insulation life is expressed as a logarithmic function of the reciprocal of absolute temperature, a straight line plot is obtained as illustrated in figure 4. Log life (hours) $= A + \frac{B}{T}$ where T is absolute temperature (°K) and A and B are

*GE registered trademark for phenolic modified polyvinyl formal coated wire.

constants.

It has already been shown that Formex wire enamel aged in oil alone at high temperatures retains its dielectric strength for long periods of time. In all cases where paper was present the dielectric strength dropped off in a much shorter period of time and there was evidence of decomposition of the paper. The paper was darkened, the oil was dark and cloudy, and there would be gas pressure inside the tube, sometimes enough to cause an explosion when the tube was opened. It has already been established that cellulosic insulations follow a chemical degradation pattern expressed by an adaptation of the Arrhenious equation.[5] For these reasons it is a logical assumption that the reduction of the dielectric strength of the Formex wire enamel in such a system is primarily dependent upon the degradation characteristics of the cellulose.

The decomposition products of dry cellulose have been investigated, and found to be mostly water, CO_2, and carbon.[6] That the decomposition rate of cellulose is increased by the presence of moisture in a sealed system has also been demonstrated by previ-

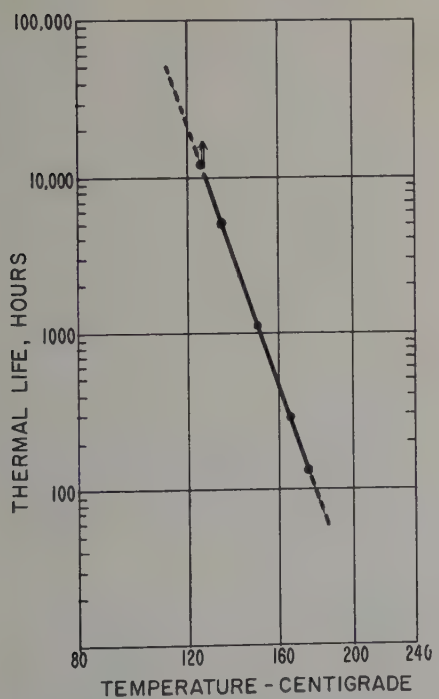


Figure 4, thermal life of Formex insulated wire in transformer oil with dry paper (<0.1% H_2O) using 50% of the initial dielectric strength as the criterion for end of life.

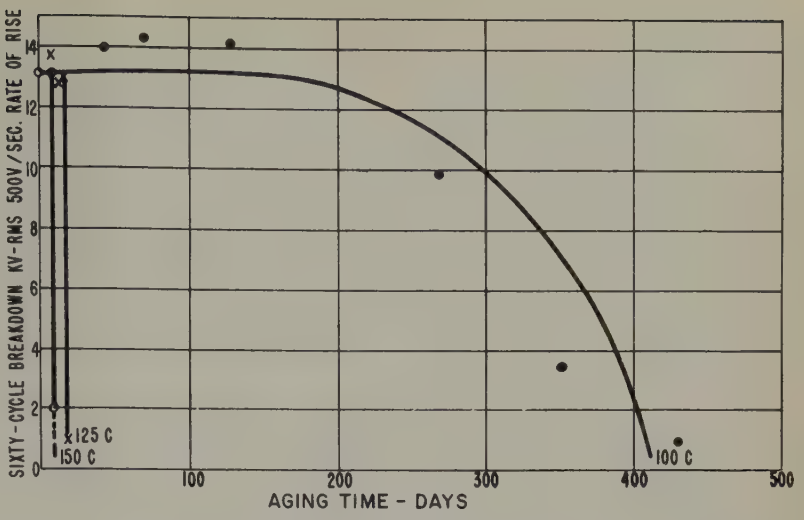


Figure 5, the effect of aging in transformer oil with Kraft paper plus 3% water on the dielectric strength of Formex insulated wire. Water based on weight of dry paper. Tests made in 105°C oil.

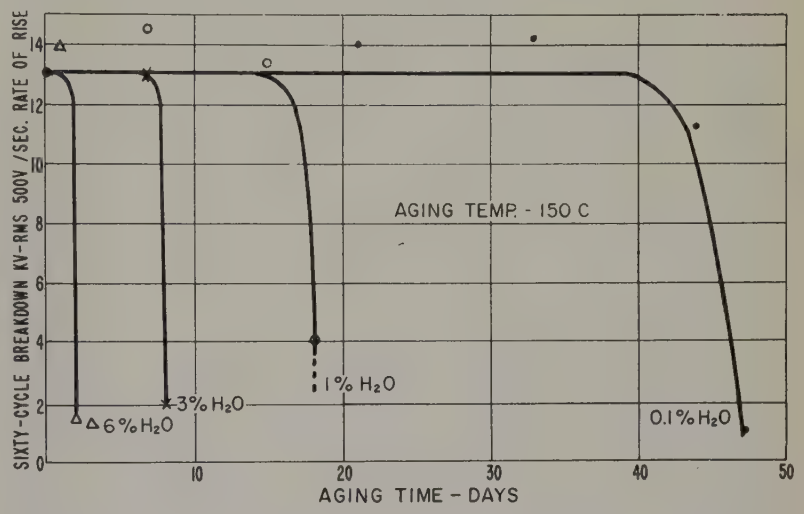


Figure 6, the effect of aging in transformer oil with Kraft paper plus water at 150°C on the dielectric strength of Formex insulated wire. Water based on weight of dry paper. Tests made in 105°C oil.

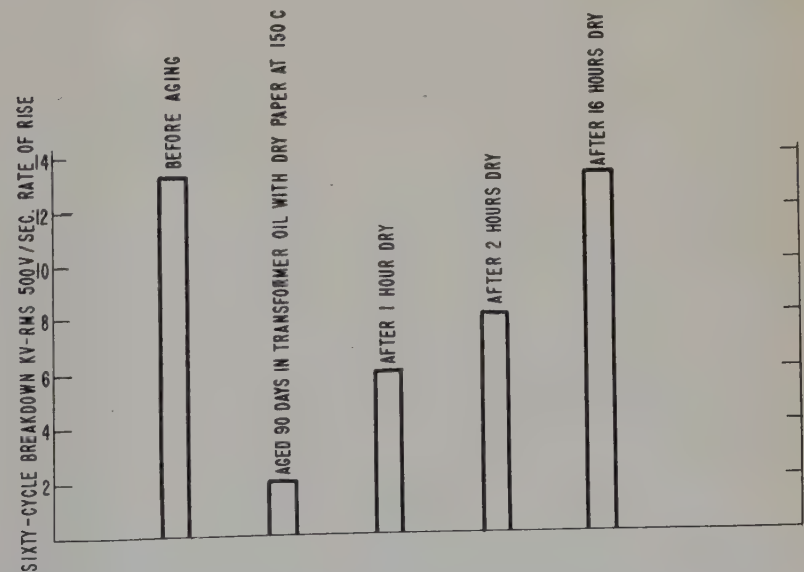


Figure 7, recovery of dielectric strength of aged Formex insulated wire by oven dry at 100°C. Tests made in 105°C oil.

ous workers.[7]

When water is added to the wire enamel aging systems, the time required for the dielectric strength to be affected is further decreased depending upon the amount of water added. Figure 5 shows the effect of 3% added water by weight of dry paper at 100°C, 125°C, and 150°C. Figure 6 shows the effect of various amounts of added water at a given temperature (150°C).

A glance at figures 5 and 6 discloses the fact that, even in the case of wet paper, insufficient decomposition products are released at once to affect the Formex wire enamel adversely. Some time is required before the cellulose is sufficiently decomposed to desorb its water of decomposition (and any added water), and this period of time varies with temperature and with initial water content. But when a certain degree of decomposition of the cellulose is reached, excess water is released, and is absorbed by the Formex wire enamel, causing a reduction in dielectric strength but with little or no effect on the film continuity since numerous microscopic examinations of aged samples have disclosed no indication of cracking or crazing. The phenomenon appears to be one of simple physical absorption of moisture, and is reversible, since heating the wire pair drives off the absorbed moisture, and the dried sample exhibits good electrical properties as is shown in figure 7.

Similar reversibility was exhibited with samples of acrylic wire enamel and urea-formaldehyde-epoxy wire enamel that had been aged in the presence of paper under like conditions.

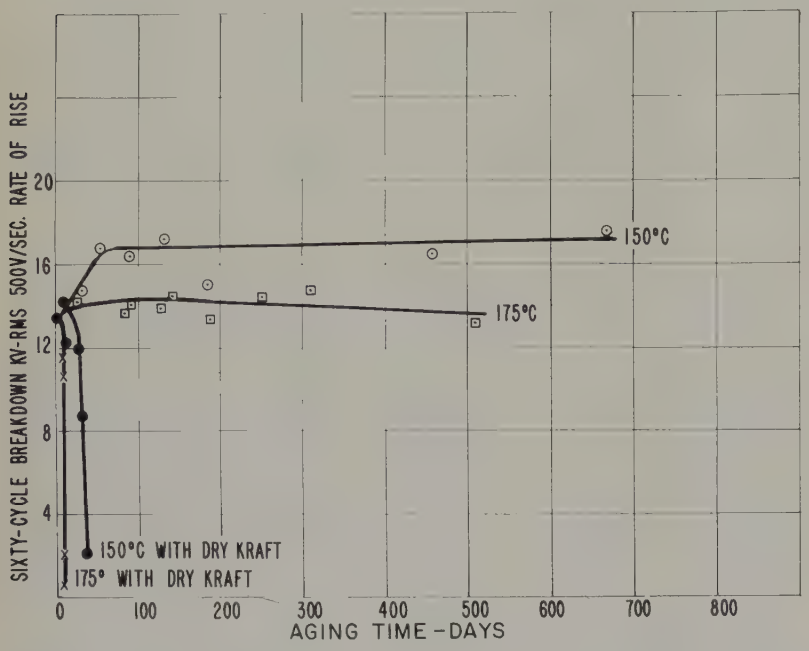


Figure 8, effect of aging in transformer oil alone and with dry paper (<0.1% H_2O) on the dielectric strength of terephthalate polyester enameled wire. Tests made in 105°C oil.

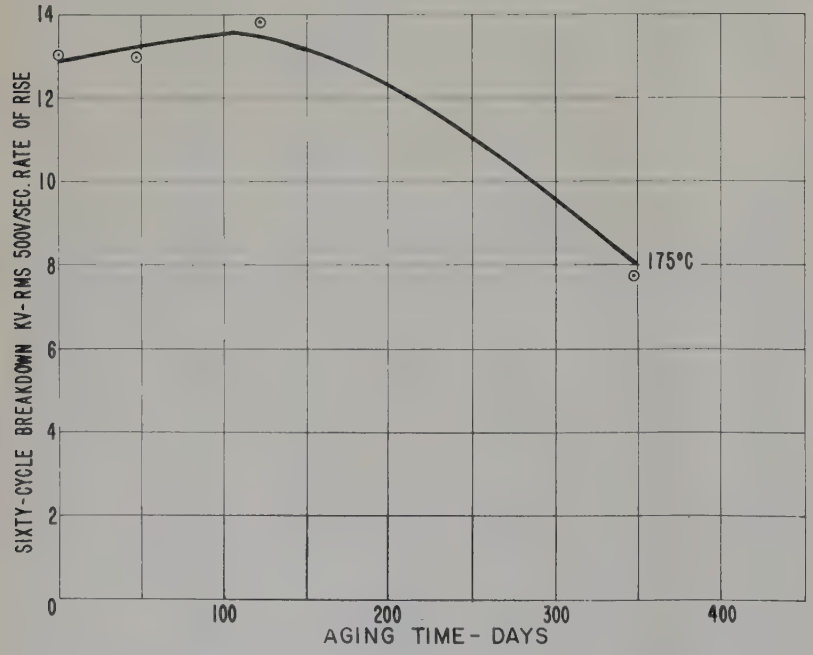


Figure 9, the effect of aging in transformer oil on the dielectric strength of terephthalate polyester-polyurethane enameled wire. Tests made in 105°C oil.

Terephthalate Polyester Enameled Wire

This type of enamel was developed primarily for use in air at relatively high temperatures, and performs quite well in this application. Figure 8 is a graph showing the aging characteristics of a terephthalate polyester enamel in oil at 150° and 175°C, with and without Kraft paper. When aged in oil alone, the terephthalate enamel retains good dielectric strength for long periods of time at the two aging temperatures, but causes severe sludging of the aging oil. Visual examination of the enameled surfaces after long time aging discloses the formation of numerous white crystals as the result of reversion of the polymer. When Kraft paper is included in the aging container, the enamel is rapidly degraded by the decomposition products of the paper, and quickly loses its good electrical properties and physical integrity.

Polyester-Polyurethane Enameled Wire

These enamels are usually of two types—solderable and non-solderable. The solderable ones are of little interest in this investigation, since the enamels are specifically designed to decompose at elevated temperatures (in a solder bath), and thus could not

be realistically tested in this accelerated aging program. The enamel tested was based on a terephthalate polyester (80%) and cyanurate isocyanate (20%) combination. Figure 9 is a graph showing the dielectric strength versus aging time in days at elevated temperatures. The dielectric strength of the enameled wire remained at a high level up to approximately 200 days at 175°C, but the oil was sludged within a very short time. These enamels were not tested in the presence of paper because of their poor resistance to hydrolysis.

Ethoxyline Resin Based Enameled Wire

Several different curing systems are used to cross link ethoxyline resins. For use in wire enamels, the most commonly encountered types have been polyester-epoxies, polyester-polyamide epoxies, and urea formaldehyde epoxies. The first two types are characterized by poor hydrolytic stability and for this reason the urea formaldehyde resin cure epoxy wire enamel was the one most thoroughly investigated. Figure 10 is a graph of kv breakdown of UF epoxy enameled wire versus aging time in days at 150°, 175° and 200°C, in oil alone and with paper at 150° and 175°C. The dielectric strength of the enamel remains at a high level as long as there is no paper in the aging container, although the aging oil does become somewhat sludged. With paper present, the enamel is rapidly affected by the cellulose decomposition products, and dielectric strength drops off at about the same rate as Formex wire enamel.

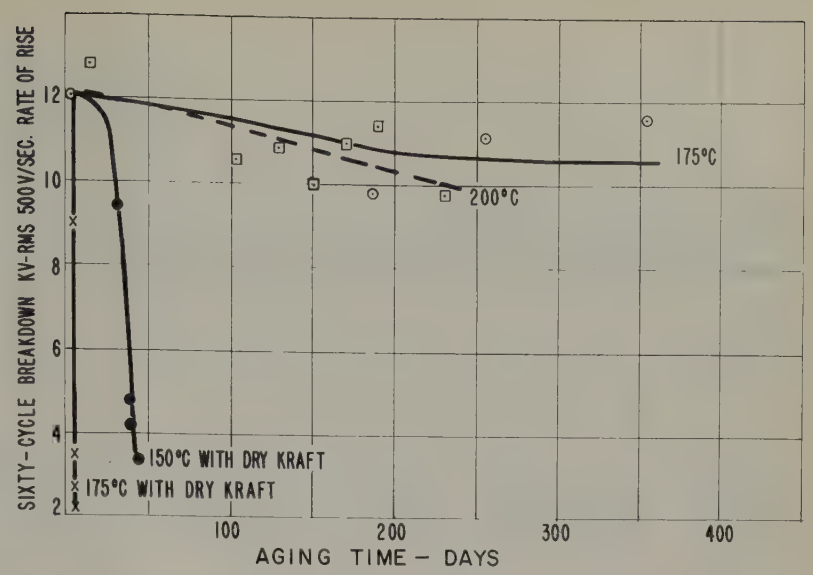


Figure 10, the effect of aging in transformer oil alone and with dry paper (<0.1% H_2O) on the dielectric strength of urea formaldehyde epoxy enameled wire. Tests made in 105°C oil.

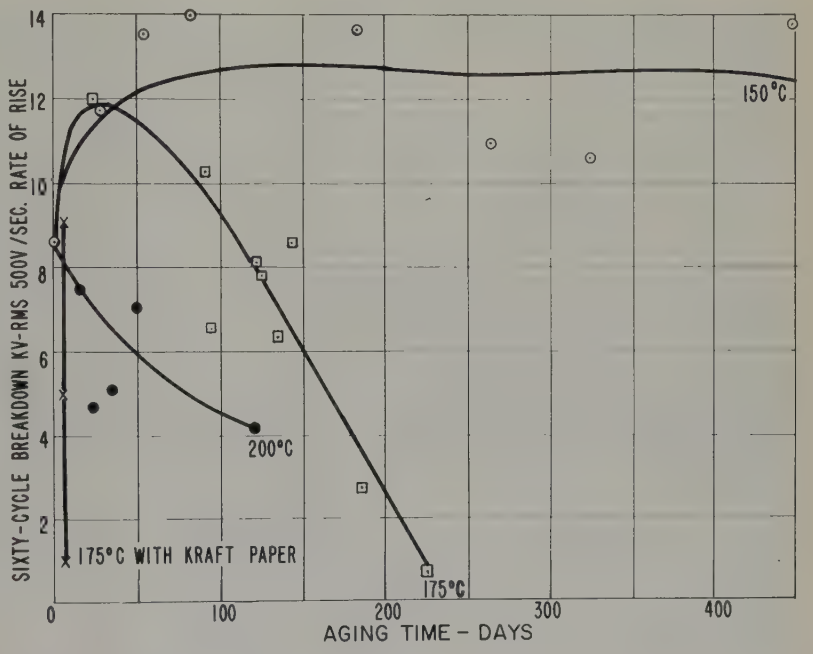


Figure 11, effect of aging in transformer oil alone and with dry Kraft paper (<0.1% H_2O) on the dielectric strength of acrylic enameled wire. Tests made in 105°C oil.

Acrylic Enameled Wire

As previously noted, the acrylic enamel tested is hydrolytically stable but is less stable at the higher temperatures than either the Formex wire enamel or the urea formaldehyde epoxy. Figure 11 is a graph of kv breakdown of acrylic enameled wire versus aging time in days at 150°, 175°, and 200°C. The rapid drop off in strength at 175° and 200°C is due to cracking of the enamel.

When tested with paper in the aging container, the acrylic enamel was found to lose its dielectric strength in about 6 days at 175°C. This loss is due to absorbed moisture in the enamel film, and is a reversible phenomenon, since drying of the sample pairs essentially restores dielectric strength.

Oleoresinous Enameled Wire

Among the earliest films for use as turn insulation are those similar to paints, and known as oleoresinous enamels. These are based mainly on drying oils, modified by alkyd and phenolic resins. The electrical and physical properties of the oleoresinous films are in general comparatively poor, and their greatest virtues were in their availability and economy. Since these enamels also show poor hydrolytic stability, and have been largely displaced by more stable materials for use in transformers, they were not investigated as thoroughly as the new enamels.

Figure 12 is a graph of kv breakdown vs. days aged of oleoresinous enameled twisted wire pairs at 175°C, alone and with Kraft paper. The

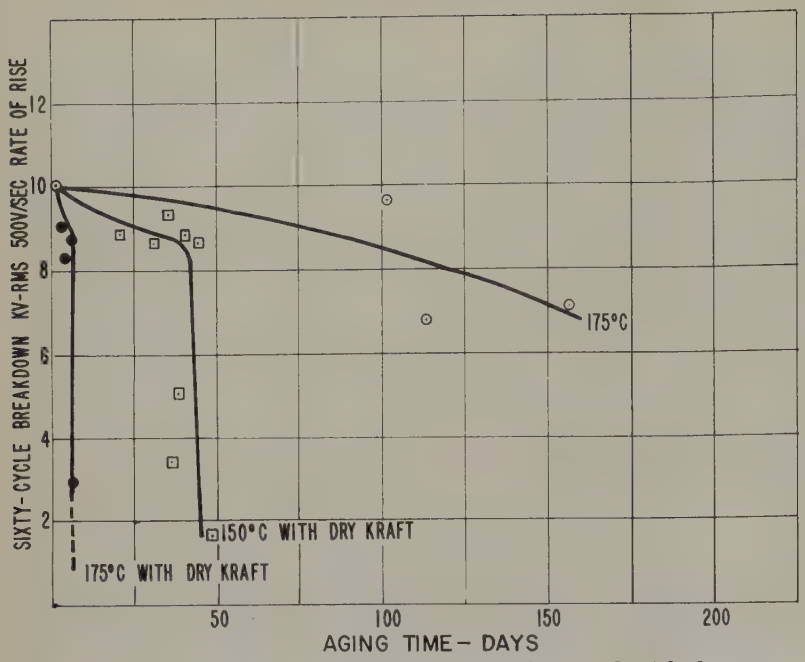


Figure 12, effect of aging in transformer oil alone and with dry paper (<0.1% H_2O) on the dielectric strength of oleoresinous enameled wire. Tests made in 105°C oil.

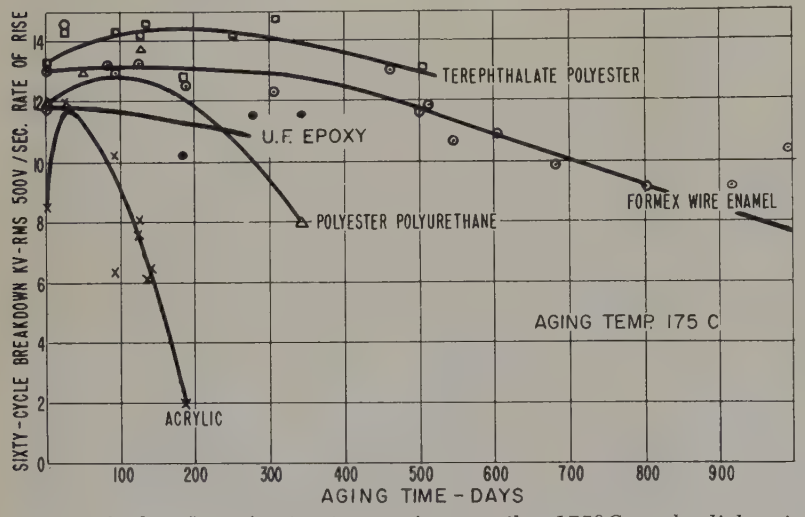


Figure 13, the effect of aging in transformer oil at 175°C on the dielectric strength of various wire enamels. Tests made in 105°C oil.

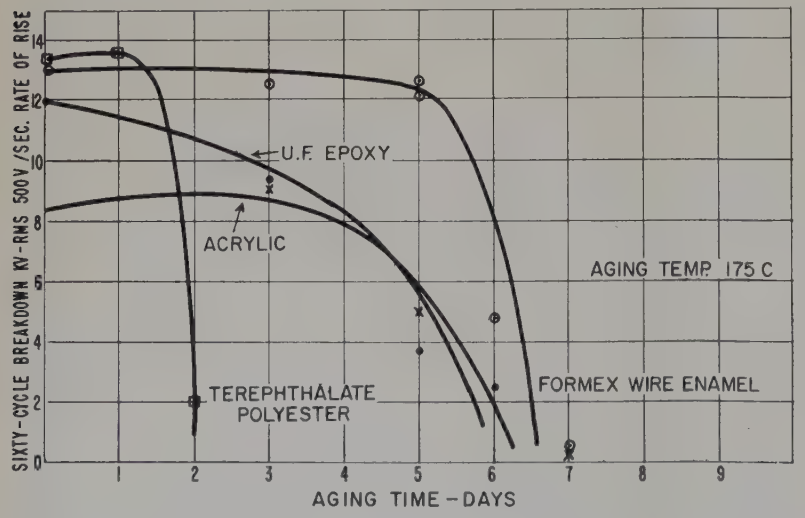


Figure 14, effect of aging in transformer oil with dry Kraft paper (<0.1% H_2O) at 175°C. Tests made in 105°C oil.

enamel has good dielectric strength after 100 days at the aging temperature without paper, but when paper is present, the electrical properties deteriorate very rapidly.

Figures 13 and 14 compare the aging characteristics of the various enamels tested in oil alone and in the oil paper system.

Conclusions

A technique has been developed for evaluating wire enamels and total insulation systems for use in liquid immersed apparatus. The data obtained by this technique and described in this paper show that:

(1) The ability of the wire enamel to function satisfactorily in this system is dependent upon both its hydrolytic stability and its dielectric strength characteristics in the presence of moisture.

(2) When the problem of hydrolytic stability is taken into account, the most suitable enamels for use in oil filled apparatus are found to be phenolic modified polyvinyl formal, urea formaldehyde resin cured ethoxyline types, and acrylic wire enamels. Of these three, the acrylic suffers most severely from stress cracking during thermal aging.

(3) The decrease in the dielectric strength of a hydrolytically stable enamel in a sealed system with cellulosic insulation is due to absorbed moisture rather than chemical degradation.

(4) The film continuity of a hydrolytically stable enamel, such as Formex wire enamel, is not affected by moisture absorption since subsequent moisture removal by simple drying essentially restores its initial dielectric strength.

References

1. Thermal Properties of Cured Polyvinyl Formal Sheet. Sprung, Guenther & Gladstone. *Industrial and Engineering Chemistry*. Vol. 47, No. 2, 1955, pp 305-314.

2. Test Procedure for Evaluation of Thermal Stability of Enameled Wire in Air. *AIEE Standard No. 57.*

3. Guide for Loading Oil Immersed Distribution and Power Transformers. *American Standard C57-92.*

4. Factors Affecting the Aging Characteristics of Various Wire Coating Materials in Transformer Oil. AIEE Trans. 1960. 60-86.

5. Electrical Insulation Deterioration Treated as a Chemical Rate Phenomenon. T. W. Dakin. *AIEE Transactions Vol. 67*, 1948, pp 113-172.

6. Gases Evolved by the Thermal Decomposition of Paper. E. J. Murphy *Transactions of the Electrochemical Society*. Vol. 83, 1943, pp 161-172.

7. Chemical Changes Affecting the Stability of Cellulose Insulation. F. M. Clark. Transactions of the Electrochemical Society. Vol. 83, 1943, pp 143-160.

News about R&A SINCE 1913 **Adhesives**

FOR ALL METALS AND ALL PLASTICS

This "100%-solids" adhesive flows like a heavy-bodied motor oil

TECHNICAL DATA ON

Bondmaster® M648T

A free-flowing, high strength, room-temperature-curing, 100%-reactive, two-component, formulated epoxy adhesive designed for bonding all metals and other rigid materials (such as glass, ceramics, plastics, plastic foams, and structural laminates) to themselves and to each other.

BOND CHARACTERISTICS

Fully cured bonds exhibit minimal shrinkage, are electrical insulators, and provide excellent resistance to weather, galvanic action, and most chemicals, acids, and alkalies.

APPLICATION

Mixed BONDMASTER M648T may be applied with trowel, spatula, knife, roller, brush, etc. Apply enough *mixed* BONDMASTER 648T to fill all cavities and depressions in both surfaces *and* to leave about 4 additional mils of adhesive on each side. Press together firmly to establish and maintain intimate contact, and cure. Pressure is not required during cure.

SPECIFICATIONS

VISCOSITY (mixed): about 10,000 cps. COLOR: clear, pale amber. BASE: modified epoxy. SOLIDS: 100%. HARDENERS: CH-8 for balance of all properties; CH-16 for best shock and peel strengths. WEIGHT PER GALLON: about 10 lbs. STORAGE: 1 year, unmixed. CONTAINERS: 1-gal. cans; 5-gal. pails; 55-gal. drums.

R&A SINCE 1913

RUBBER & ASBESTOS CORPORATION

226 BELLEVILLE AVENUE
BLOOMFIELD, NEW JERSEY

Don't let the "100%-solids" term confuse you . . . this modified epoxy adhesive is a free-flowing liquid!

BONDMASTER M648T ("T" for "thin") exhibits all the smooth mixing characteristics and ease of handling of a 10,000 cps fluid—can be applied by brush, spatula, roller, spreader, or similar conventional equipment.

As with all BONDMASTER formulated epoxy adhesives, M648T yields high strength bonds on all rigid metals and just about any plastic or plastic laminate. In addition, its lower viscosity makes it ideally suited for work on flexible plastic sheets (like bondable Teflon) or fragile cells of rigid plastic foams (like Styrofoam) as well as on thin metallic foils of all types.

100% REACTIVE

The glue line thickness you put down won't shrink, either during the cure or after it . . . this formulation is 100% reactive. (There is no wait for solvent evaporation either.) Mere contact pressure is sufficient.

CURES AT ROOM TEMPERATURE

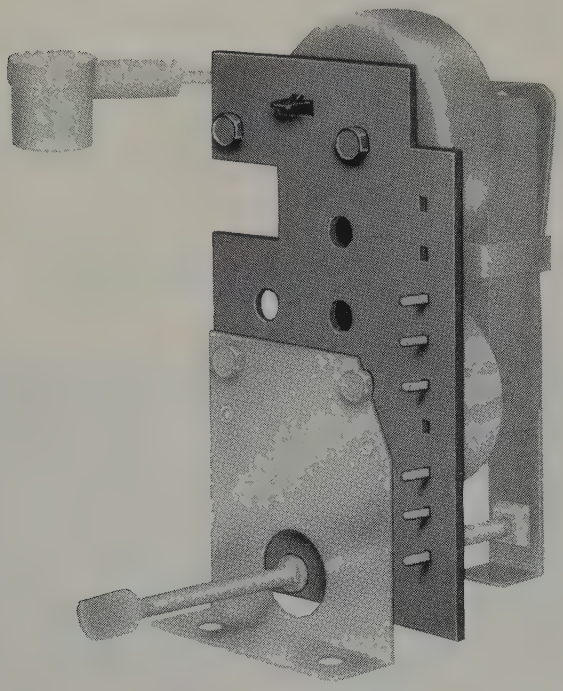
A bond that's strong enough to permit handling of your assembly develops at room temperature in from 4 to 6 hours; about 85% of maximum strength in less than one day. Alternately, if you can heat-cure, you can reach full strength far more rapidly—in as little as 10 minutes at 250°F., for example.

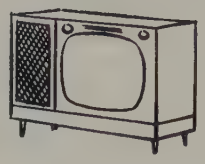
WRITE FOR FURTHER DATA

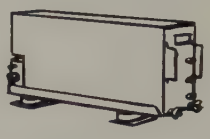
Write for Technical Data Sheet describing this 100%-reactive, free-flowing liquid epoxy adhesive formulation. We will be glad to send a free evaluation sample as well if you will describe your bonding problem in detail.

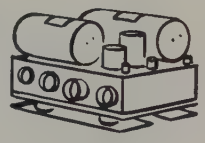
Print Ins. 16 on Reader Service Card

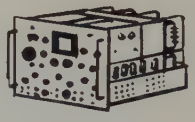
NEW SPAULDITE XXXP-770 PHENOLIC LAMINATE COMBINES *COLD PUNCHING* AND *FIRE RESISTANCE* . . . COSTS LESS THAN PAPER EPOXIES











TYPICAL PROPERTIES OF XXXP-770 — 1/16″ Thickness

Thickness Range	1/32 - 3/16″
Punching Quality	Cold
Shearing Quality	Cold
Water Absorption %	0.65
Dissipation Factor 1 MC	
Condition A	.029
Condition D-24/23	.034
Dielectric Constant 1 MC	
Condition A	4.4
Condition D-24/23	4.6
Dielectric Strength Parallel to Plys KV	
Condition D-48/50	49
Rockwell Hardness M Scale	
Condition A	78
Flame Test D635 Inches Burned	
(in 2 ignitions after 28 days at 135°C)	5/8

COPPER CLAD XXXP-770

Surface Resistivity — ohms/cm sq.	
Condition C-96/35/9	1×10^{13}
Peel Strength as rec'd and after solder dip	
lbs./in. width	8.0
Solder Blister at 500°F Seconds	15.0

Because Spaulding can fabricate XXXP-770 with lower cost cold punching methods, this new phenolic laminate offers you greater savings and efficiency in the design and production of high volume electronic parts that require self-extinguishing characteristics.

Write for complete data on Spauldite XXXP-770 and Spaulding's other fire-resistant grades.

SPAULDING FIBRE COMPANY, INC., 392 Wheeler Street, Tonawanda, New York

Print Ins. 17 on Reader Service Card

Electrical Insulation in IEC New Delhi Meetings

By K. N. Mathes, General Electric Co., Schenectady, N.Y.

Twenty-two technical committees of the International Electrotechnical Commission held meetings at the general meeting in New Delhi, India. The Indian Standards Institute, as host, provided exceptionally good meeting facilities and a tremendous program of entertainment, receptions, banquets, and educational tours. The tours included among many others a visit to the Taj Mahal, an excursion to the developing Bhaknra-Nangal power project in the foothills of the Himalayas, and, at the close of the meeting, a 10-day program of visits to Indian industry including many in Calcutta, Madras, Bangalore, and Bombay.

The tremendous technological effort under way in such a relatively underdeveloped country as India provides an interesting and hopeful contrast to the everyday activity and way of life which seems at first so strange to Western eyes. India is so obviously a land of terrific contrasts that a visit cannot fail to make a great and exciting "impact."

Insulation Committee Activity

IEC Technical Committee 15 on Electrical Insulation has for some time met every second year. In 1958 at Västeras, Sweden, it was decided to form a Steering Committee consisting of chairman, secretary, chairmen of working groups, and one member at large from three countries selected by the membership. This steering committee met at Madrid, Spain, in 1959 and decided to hold its 1960 meeting at the General Meeting in New Delhi, India, despite the fear by some that the great travel distance might interfere with attendance.

Organization of IEC Technical Committee 15

Committee	Chairman	Country	U.S. Delegate
TC-15, Insulating Materials	Dr. E. F. Richter	Germany	Dr. A. H. Scott
WG-1, Electric Strength	W. Devenish	United Kingdom	(Did not meet)
WG-2, Volume and Surface Resistivity—Insulation Resistance	Dr. A. H. Scott	USA	K. N. Mathes
WG-3, Tracking	R. D. Poppe	Norway	K. N. Mathes
WG-4, Voltage Withstand under the action of ionizing discharge	J. Fabre	France	(Did not meet)
WG-5, Encyclopedia of Insulating Materials	Dr. G. de Senarclens	Switzerland	K. N. Mathes
WG-6, Dielectric Constant and Loss	Dr. H. Roelig	Germany	(Did not meet)
WG-7, Temperature Properties	J. F. Dexter	USA	(Did not meet)
WG-8, Influence of Radiation on Insulating Material	Dr. P. Olmer	France	(Did not meet)
WG-9, External Liaison*	R. I. Martin	United Kingdom	Dr. A. H. Scott
WG-10, Electrolytic Corrosion**	K. N. Mathes	USA	(Did not meet)

**Formed at the steering committee meeting in Madrid 1959 and approved at the New Delhi meeting of TC-15.*

***Formed and approved at the New Delhi meeting of TC-15.*

At the New Delhi meetings of TC-15, 18 countries were represented (one more than in Sweden) with 44 delegates in attendance. A number of working groups did find it impossible to obtain adequate attendance so did not hold meetings in New Delhi. In contrast, the several working groups which did meet found great interest and active participation.

Since electrical insulation is a dynamic technology, it is to be expected that change in activity and organization will continually occur. One of the principal functions of the steering committee concerns recommendations for such change and for new activities. In consequence, the organization is continually evolving and its latest form is given in the table.

Much of the actual work occurs in the working groups with TC-15 as a whole providing instructions and a basis for action along with review and approval of accomplishments. In the following, the activities concerning each working group are summarized.

WG-1—Although WG-1 held no formal meeting, the chairman, Mr. Devenish, was present and considerable discussion of the recently voted document on electric strength took place in TC-15. Many countries commented that the present draft is not truly a standard but more nearly a description of the various methods used in several different countries. It was agreed that the working group should attempt to obtain agreement on just *one* preferred method for each type of test by majority vote—item by item. The United States delegation strongly supported this position.

WG-2—Several documents have been returned by TC-15 after voting with instructions for revision. Many of these changes are too detailed to

be described here. It was possible in the document on conditioning methods to introduce a descriptive code much like that now used in the United States and several other countries as follows:

Unconditioned	A
Room Condition	B—hrs/°C/%RH
Conditioning	C—hrs/°C/%RH
Liquid Immersion	D—hrs/°C
Heating or Cooling	E—hrs/°C/%RH (if needed)

The editorial details were left to the chairman, Dr. Scott.

Standard exposure times were also suggested as follows:

Hours—1, 2, 4, 8, 16, 24, 48, 96

Weeks—1, 2, 4, 8, 16

Modifications were made in the tables of standard conditions and a condition of 23±0.5°C was accepted as the "normal" temperature for water immersion despite the Indian delegation's objection since they would prefer 27°C.

In the document describing cells for measuring resistivity of liquids it was accepted that the CIGRE cell would replace the Berberich cell now shown, but the principle was established that any cell meeting the requirements of the method would be considered satisfactory. A number of delegates had previously wished to specify a group of specific cells, but this position was strongly opposed by the American delegation and upheld.

WG-3—The chairman, Mr. Poppe, restricted the initial discussion to items for a proposed addendum to IEC publication #112 on comparative tracking index in which techniques and precautions for improving the consistency of the test were discussed including: Surface Preparation — Sample and Electrodes, Nature of Electrode Material, Electrode Contact with the Sample, Uniformity of Contaminant Drops, Sample Size Including Thickness, and Characteristics of the Over-Current Relay.

Several modified or new tracking techniques were discussed. Mr. Harasimowicz, the Polish delegate, reported a new amended test for high voltages. Mr. Kovitsky of the USSR stated that an improved method, with better sensitivity to changes in materials but with less variability in the test itself, will be sent out in three months.

Mr. Mathes, the United States delegate, mentioned a paper on the Dust-Fog Test by Dr. G. L. M. Sommerman which had been sent to the Working Group members. He was also given an informal opportunity to describe the new, inclined plane, liquid contaminant test and to present a short descriptive movie.

WG-4—Prof. Olmer of France reported for the chairman, Mr. Fabre, that comments were being received on the document informally describing methods for determining the effects of ionization. A meeting of the working group is planned for Paris in April 1961.

WG-5—The chairman, Dr. de Senarclens, held both a meeting of the working group and a joint meeting with TC-15. A request by the United Kingdom in considering the Encyclopedia of Insulating Materials and proposed detailed monographs had previously led the IEC Committee of Action to demand that:

1. Independent financial support for development, translation, circulation, and publication be found.
2. The Chairman of TC-15 guarantee the technical competence of the documents and report thereon to the Committee of Action before publication.
3. A way of publishing be found to give credit to the IEC without implying its full sponsorship.

These problems were solved primarily by a number of National Committees, including the United States, which agreed to take technical and financial responsibility. Although the United Kingdom as a national body was restricted from participation, it was indicated that individuals had an interest in participation in the work.

The working group considered in outline 12 monographs on different insulating materials prepared by the Swiss Committee. In the course of these discussions, an appropriate, acceptable pattern for the development of future monographs appeared to develop. It was agreed that generally descriptive and precautionary information on insulating materials would be given with only limited reference to specific results of tests. Data for materials would be presented showing comparative properties and curves so far as possible to show trends and the influence of service conditions. It was accepted that the monographs should be developed primarily for the design engineer concerned with the building of electric equipment rather than for purposes of specification or control.

Dr. de Senarclens stated that the monographs on most of the groups of materials now described in the Synoptic Tables (Now published in French, German, Polish, and Russian, and shortly to be published by the AIEE in English) should be available in about four years.

WG-6—Dr. Richter acted for the chairman, Dr. Roelig. Detailed discussion took place in TC-15 on comments received on the IEC method for power factor and loss index. As with resistivity, it was agreed that cells for measuring liquids should be included as illustrations of the possible types.

WG-7—Mr. Dexter reported on comments received on several thermal aging documents. In specific action, TC-15 instructed the chairman of Working Group 7 to consolidate the comments received and to produce one or two standard charts for plotting thermal life data against temperature.

WG-8—The chairman, Prof. Olmer, reported the circulation of a questionnaire concerning the materials and types of radiation believed to be important. Replies have been received from nine countries. Results of work on PVC, polyethylene, ceramics, polyester film, and magnesium oxide have been circulated in the group.

WG-9—This working group proposed by the steering committee of TC-15 in Madrid in 1960 was given its formal title and scope by the full committee. The scope is limited to the consideration of action and request on insulating material originating outside of TC-15 and to proposing areas of need for new working groups on specific subjects. Action started on printed circuit boards was dropped since the IEC Committee of Action

set up a full committee on the subject.

The chairman reported his action in recommending measurement of insulation resistance after water immersion to TC-18 on Electric Equipment for Shipboard Applications. TC-18 in reply asked for suitable minimum values of insulation resistance for their application. Much discussion centered about two points of view.

1. So many factors were represented in shipboard application of electrical insulation that minimum values of insulation resistance appeared to be meaningless.
2. Information should be obtained on minimum values in response to the request in the hopes that something of value might emerge.

Because of urgent need, WG-9 suggested that a new working group on Electrolytic Corrosion be set up by TC-15. This action was implemented in the TC-15 meeting.

Conclusions

In the development of international specifications on insulating materials, much detailed work is needed. Ultimately optimization and compromise among the views of many nations must be obtained. Such progress is being obtained in many areas by IEC Technical Committee 15. It has been apparent that new areas of insulation technology can be developed in the international area most easily before individual national views are fixed by years of practice and opinion. It became very apparent at the New Delhi meeting also that newly developing countries like India have a particularly great need for international specifications in many areas. In such countries years of practice and experience are not available. International specifications provide a much needed help to the rapid industrialization under way.

No one who has seen the rapidly developing industry and economy of a country like India can fail to be impressed. Technological help from more developed countries is an obvious need in the development and stability of the free world. In this, international standards on electrical insulation form an important part.

European Insulation Report

Ed. Note: *The author of this monthly European report is a well-known insulation expert associated with a large European electrical manufacturer. Although it is necessary that his identity not be revealed at this time, correspondence may be exchanged with him by writing* European Editor, Insulation, Box 270, Libertyville, Illinois.

In the journal "Elektrie" (E. Germany), No. 9, Vol. 14, September 1960, there appeared various articles on the application of epoxy resins. The East Germans themselves have very little experience of their own, but they take almost everything from the West, so that the articles give a good survey of West European technique. Anyway it seems that they manufacture their own epoxy resins which have remarkable properties.

Most of the articles are a little too optimistic. Care and attention are demanded already with elements which come in contact with open air, arcs, and apoplectic stresses. The given fabrication methods depend, of course, on the resins manufactured in East Germany and Czechoslovakia. Quartz powder (to 200%) as a filler, Aerozil as a suspension material, and an accelerating and a curing agent are mixed with the resin. Epoxies which cure with and without heat are described. The material is seldom reinforced with glass fibers or fabric. The resin is seldom cast in vacuum although the resin is mostly de-gassed before casting.

The Properties of Epoxy Resins for Applications in Electrical Engineering by G. Mensching (Berlin) and *State of the Electro-Technical Applications of Casting Resins in Czechoslovakia,* by V. Roth (Prague).

These give tables and curves on the behavior of different resins, filled and unfilled. The essential data of the East German and Czechoslovakian products correspond approximately to those of Araldit of CIBA (Basel, Switzerland). It is rightly observed that the properties of the cast can be essentially influenced by the filler content, by the accelerating and curing agents, by the curing temperature, etc. Most of the epoxies are plastic-elastic above 80°C and soft (rubber)-elastic above 150°C. The resistance to aging is good to 150°C (mechanical values, loss of weight).

The Casting Resin Technology in Electrical Engineering, by G. Mensching (Berlin).

One needs the following in a foundry:

1) Mixing contrivance for the preparation of the casting material. Except for cold cured resins, a fusing of the resin and heating of the admixture is necessary. Mixing in vacuum is advantageous because all the air would be eliminated.

2) Casting arrangement.

3) An adjustable electric oven (to 180°C) would be highly suitable for curing. Two ovens would be advantageous since a post-curing is often necessary.

4) A vacuum plant is indispensable when a high quality void-free mold is necessary. High electrically stressed parts must be cast in vacuum.

5) Auxiliary equipments for pre-drying, molding, de-greasing, surface treatment, protection, etc.

The article also deals extensively with the different possibilities for manufacturing molds.

The Thermal Breakdown of Epoxy Resins, by E. Vetter (Institute for High Voltage Technology in the Technical High School, Dresden).

The investigation was carried out according to the methods of K. Halbach ("Investigations on the Breakdown and Dielectric Losses of Some Solid Insulation Materials." Archiv für Elektrotechnik, vol. 21, 1929, pp. 535-563). That is, the voltage was applied to a resin sheet which was placed in a heated bath. The power factor (tan δ) was measured with a Schering bridge with guards on the grounded electrode. The sample tested was an Epilox EG 1 with 30% phthalic anhydride as the curing agent, and 50%, 100%, and 200% respectively of quartz powder. The sample sheet was cast with de-gassed resin and cured at higher temperature.

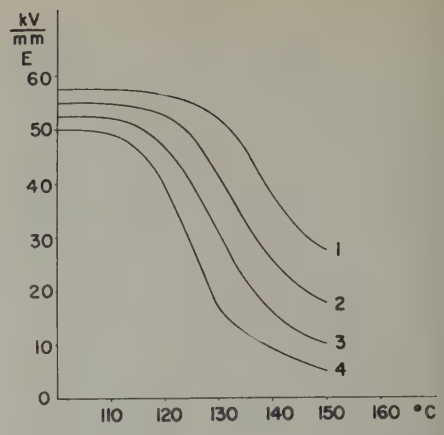


Figure 1, breakdown strength $E\left(\frac{mm}{kv}\right)$ *as a function of the ambient temperature of the sample. 1) Epoxy with 200% quartz powder. 2) Epoxy with 100% quartz powder. 3) Epoxy with 50% quartz powder. 4) Pure epoxy resin.*

The results of the test are shown in figure 1. As can be seen, the quartz powder addition increases the temperature at which thermal breakdown occurs. This does not correspond to expectation because the quartz powder increases the dielectric constant K and the power factor tan δ. Of course, the thermal conductivity λ also improves (λ for pure resin= 0.17 kilo cal/m/hr/°C; for resin with 200% quartz powder=0.76). Since the heat transfer of insulating materials also depends on the medium in which it is embedded, the results given are valid only for oil.

Casting Resins in Cable Technology, by C. Meisel.

This article deals with the possibility of using epoxy resins for the purpose of filling up socket-joints. Both polyester and epoxy hardly bond with PVC. With aluminium sheaths, the latter has to be thoroughly cleaned so that bonding is possible.

The European Editor does not really see why the technique used at the present time should not suffice and asks whether it is relevant to use epoxy here.

R. Franke (Berlin) even asserts in his contribution, *Application of Epoxy-Resins in High Frequency Technology,* that the industrial branch of electrical technology could never attain the world standard without the epoxies.

Casting Resin as Material for the Construction of Middle and High Voltage Switchgear, by H. Bernhard (Berlin).

He refers to the examples of use such as connecting rods, insulators, switch levers, pressure and switching chambers, etc., for circuit breakers and disconnecting switches especially to 30 kv rating. There is as yet no proof of the suitability for use outdoors. Anyway, the examples of 87 kv bushings are known. In general, porcelain and pressed paper are being gradually replaced by casting resins.

The good resistance to arcs offers excellent possibilities in application and space saving. The arcs burn the surface of the insulator. But thanks to the large content of quartz powder, the burn cannot penetrate any further. A cleansing of the surface is sufficient in order to put the insulator back in service. The use of this casting resin for the switching chamber part of equipment to 500 kv (mostly outdoor) is made possible by using a porcelain cover. This can be done away with when the cast resin can be made resistant to outdoor conditions. When using casting resins for switching-chamber elements, it should be noted that these form fission products when in contact with arcs, and the deterioration of the surface properties could cause restriking of the arc to occur.

General advantages claimed are excellent mechanical and electrical values over a wide temperature range; adhesion to metals and ceramic; insensitivity to chemicals, humidity, etc.; remarkably good damping capacity with respect to continuous oscillation stresses; great freedom in the formation and shaping of the parts; possibilities of casting coils, fastening and fixing elements, etc.; small investment costs (simple foundry, curing without pressure at relatively low temperatures); and very good surface quality without finishing.

The author demands greater mechanical strength above 80°C for the future because at present the values deteriorate very quickly above this temperature. He also asks for an improvement in the material by means of painting or using a more suitable curing agent so that the material will resist outdoor weather conditions.

Association News

New Officers of SPI Cellular Plastics Division

Dr. Samuel Steingiser, Mobay Chemical Co., and Edwin A. Edberg, Dylite Foam Dept., Koppers Co. Inc., have been re-elected chairman and vice chairman, respectively, of the Cellular Plastics Division of The Society of the Plastics Industry, Inc. They will serve for the next two years.

New NISA Directors

Four new national directors of the National Industrial Service Association have been elected and two others re-elected.

The new directors are: Edward G. Potter, Lima Armature Works, representing West Virginia, Kentucky, and Ohio; Carlton A. Andrews, Jones Electric Repair Co., representing Virginia and the Carolinas; Paul V. Bush, Lubbock Electric Co., representing Texas, Arizona, Oklahoma, New Mexico, and Mexico; and Earl S. Brooks, United Electric Motors, representing Alaska, Montana, Oregon, Washington, and Idaho (Region 16).

Re-elected to second terms were Warren C. Mielke, Mielke Electric Works, representing Minnesota, the Dakotas, and part of Wisconsin (Region 10); and Ed Kolhonen, Peabody Electric Co., representing New England (Region 1).

New NEMA Officers

A. D. R. Fraser, Rome Cable Div., Aluminum Co. of America, has been elected president of the National Electrical Manufacturers Association. He succeeds N. J. MacDonald, The Thomas & Betts Co. Inc.

W. R. Persons, The Emerson Electric Manufacturing Co., was elected vice president, and A. E. Pringle, II, The Pringle Electrical Manufacturing Co., was elected treasurer.

The following members have been elected to the NEMA Board of Governors for a term ending in 1963: H. G. Blakeslee, Cory Corp.; H. F. Lehman, Frigidaire Div., General Motors Corp.; N. J. MacDonald, The Thomas & Betts Co.; E. F. Mulligan, Abolite Lighting Div., Jones Metal Products Co.; Louis E. Newman, Smithcraft Corp.; W. R. Persons, The Emerson Electric Mfg. Co.; A. E. Pringle, II, The Pringle Electrical Mfg. Co.; and Leslie H. Warner, General Telephone & Electronics Corp. Appointed for one-year terms were Howard T. Brinton, Phelps Dodge Copper Products Corp., and E. S. Ruth, The Gamewell Co.

Morss Given Award At Annual NEMA Meeting

Everett Morss, Simplex Wire and Cable Co., was honored at the 34th annual meeting of the National Electrical Manufacturers Association with the presentation of the James H. McGraw Award Manufacturers Medal. Morss was cited "for his initiative and dedicated industry leadership in the development of modern synthetic insulation (a high molecular weight polyethylene) for electrical conductors to the great benefit of the electrical industry."

WESCON Call for Papers

A call-for-papers for the 1961 Western Electronic Show and Convention has been issued. WESCON will be held next August 22-25 at San Francisco's Cow Palace.

May 1 is the deadline for submission of 100-200 word abstracts and 500-1000 word detailed summaries of papers to be considered for inclusion. Submissions should be sent to the attention of E. W. Herold care of WESCON, 701 Welch Rd., Palo Alto, Cal.

IPC Gains 3 New Members, Annual Meeting Scheduled

Three more companies have become members of the Institute of Printed Circuits. Elected to regular membership is Combined Electronics Inc., Cicero, Ill. George F. Johnson will be the official representative.

Newly elected associate members are: Advance Process Supply Co., Chicago, and Cleveland Graphite Bronze Division, Clevite Corp., McConnellsville, Ohio. Melvin Greene will be the official representative of Advance, and L. D. Ridenour will represent Cleveland Graphite.

Members of the IPC will meet in New York, March 21-22, 1961 for their Third Annual Meeting. For information on membership in the Institute of Printed Circuits, contact the IPC office, 27 East Monroe, Chicago 3.

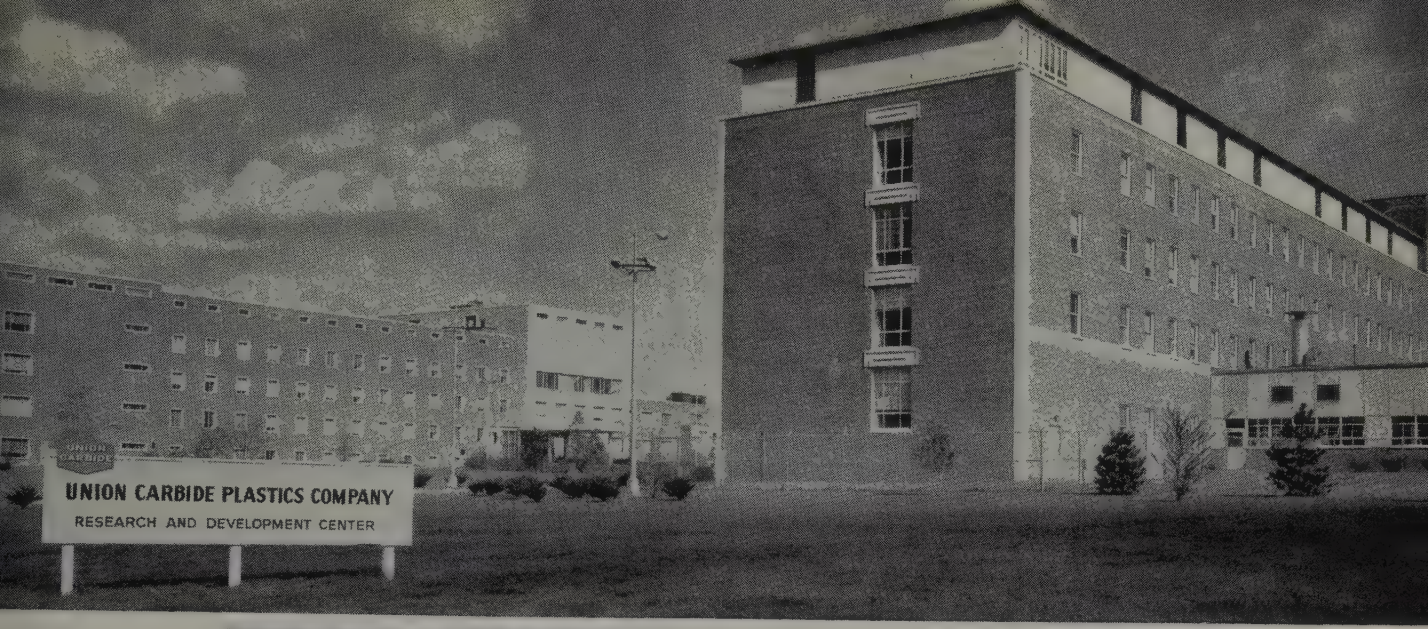
Cassidy Heads Pacific Electronic Trade Show Sponsorship Committee

Don Cassidy, president of WESCO Electronics in Pasadena, will head the Committee for Sponsorship of the 1961 Pacific Electronic Trade Show which will be held in Los Angeles' Great Western Exhibit Center, February 26-March 1. One of the principal objectives of PETS is to provide a comprehensive exhibit and conference medium for western electronic distributors.

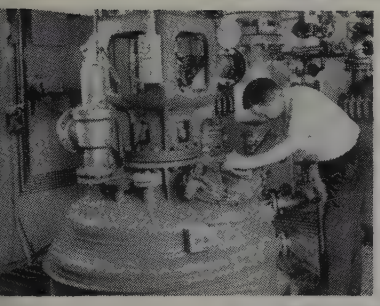
However, it is also planned to form an "Exhibitor Council for Show Development" following the 1961 show, "for the purpose of expressing the manufacturers' needs and wishes with respect to the future development of the Pacific Electronic Trade Show." During the show, a conference area within the exhibit area will provide facilities for manufacturer-distributor conferences and private consultations for the entire four days.

Plastics Institute Conference

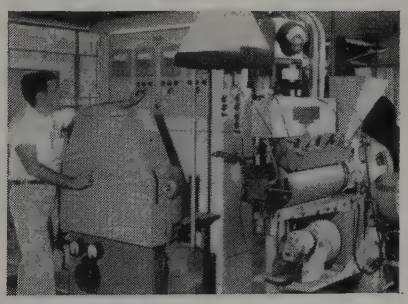
The Plastics Institute (England) has arranged the following Conferences: March 1, 1961, "Rubber and Plastics in Cables," joint conference with the Institution of the Rubber Industry to be held at the Institution of Electrical Engineers, Savoy Place, London W C 2; June 19 and 20, 1961, "Education and Training in the Plastics Industry," to be held at the Institution of Electrical Engineers, London; October 21 and November 1, 1961, "Engineering with Plastics," to



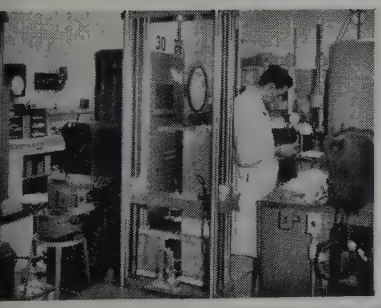
Formulation of New Materials



Production of Experimental Quantities



Study of Extrusion Characteristics and Techniques



Evaluation of Physical and Electrical

Proven Products—Ready to Serve You

Unsurpassed facilities for Plastics Research and Development

LEAD TO UNSURPASSED INSULATION AND JACKETING

Pictured are the buildings of Union Carbide Plastics Company's modern and extensive Research and Development Center at Bound Brook, N. J. Here are found unmatched facilities for the development and evaluation of the newest and the widest variety of polyethylene and vinyl insulating and jacketing materials for the Wire and Cable Industry.

Take a look at just a few of the activities carried on at this Center to help fulfill your present and future needs. These range from the formulation and careful testing of the newest and most improved quality materials . . . to the study of modern extrusion methods so vital to the production of superior products. Your future requirements are anticipated by long-range development programs that seek to broaden the range of properties which could expand the use of plastics. And too, these same facilities are available to solve your special problems or requirements. Better products and better customer service . . . these add up to the kind of assistance that can save you valuable time and money.

You stand to gain immeasurably from the unsurpassed experience and technical knowledge of one of the oldest and most progressive producers of polyethylene and vinyl for insulation and jacketing. For more information, about BAKELITE Brand Plastics, write Dpt. IS-75B, Union Carbide Plastics Company, Division of Union Carbide Corporation, 270 Park Avenue, New York 17, N.Y. *In Canada:* Union Carbide Canada Limited, Toronto 12.

UNION CARBIDE

Print Ins. 20 on Reader Service Card

be held at the Institution of Electrical Engineers, London.

NEC Elects 1961 Officers

Joseph J. Gershon, Director of the Resident School, De Vry Technical Institute, Chicago, has been elected president of the National Electronics Conference for 1961. Other officers named for the 1961 conference, which will be held in Chicago at the International Amphitheatre October 9-11, are: vice president, James H. Kogen, GPE Controls Inc.; secretary, Dr. Thomas F. Jones Jr., Purdue University; treasurer, Robert J. Parent, University of Wisconsin; assistant treasurer, Dr. James S. Aagaard, Northwestern University.

Motor Control Courses Conducted by EASA

Six electronic motor control courses for employes of independent electrical apparatus service firms in North America will be held in major cities in March, April, and May by the Electrical Apparatus Service Association, Inc. EASA is the new name of the National Industrial Service Association, Inc., effective April 1, 1961.

The five-day courses will be held in Philadelphia, March 6-10; Boston, March 20-24; Atlanta, April 3-7; Oklahoma City, April 17-21; Los Angeles, May 1-5; and Minneapolis, May 15-19. Each course will be directed by G. D. Long, instructor of maintenance schools, Reliance Electric & Engineering Co., Cleveland, Ohio.

The program will begin with lectures and discussions on basic electricity and electronics and range through control of motor and generator fields, variable speed control, internal circuitry, trouble shooting methods, magnetic amplifiers, and other related topics.

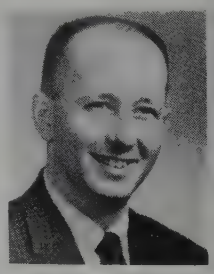
Courses will be limited to 50 persons each on a first-come, first-served basis. An enrollment fee of $65 covers text and laboratory materials, equipment rental, and overhead. Applications should be sent to A. A. Baechle at EASA headquarters, 7730 Carondelet Ave., St. Louis 5, Mo.

Narrow Fabrics Institute Names New Officers, Increases Membership

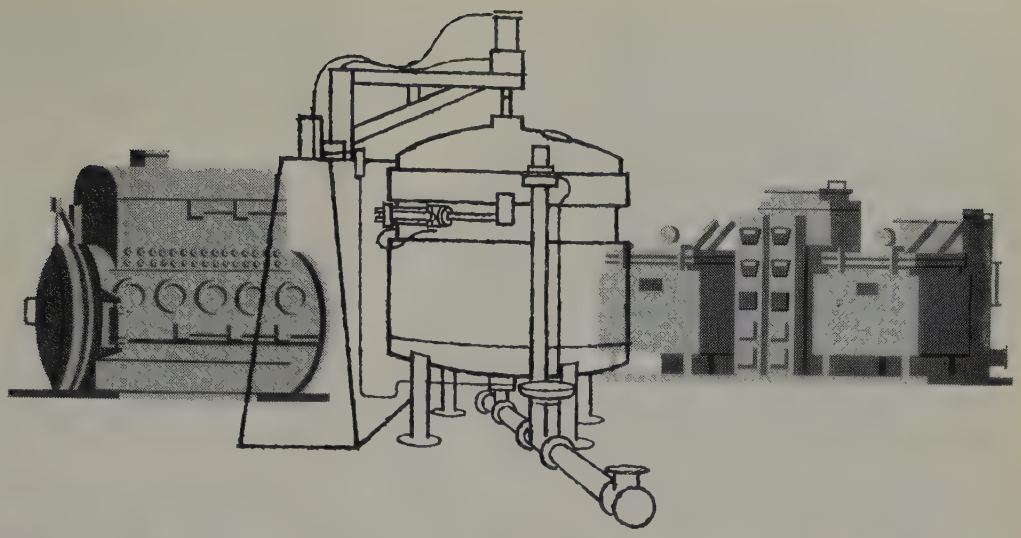
At the recent annual meeting of the Narrow Fabrics Institute, John A. DeAngelis, Murdock Webbing Co., was elected board chairman for 1961. Other elections included E. B. Laughlin, Laughlin Textile Mills, president; Thomas R. Beecher, Globe Woven Belting Co., vice-president; A. A. Kuhn, Fiber Manufacturing Co., treasurer; and John Peffer, Buffalo Weaving & Belting Co., secretary.

The Institute also added as active members Arbeka Webbing Co., Pawtucket, R.I., and the Russell Manufacturing Co., Middletown, Conn. The M. E. Seddon Corp., New York City, is the most recent addition to its associate member group.

Metz Chosen to Head Plastics Distributors



August Metz, general manager of the Pittsburgh branch of Commercial Plastics & Supply Corp., New York City, has been elected president of the United Plastics Distributors Association. The UPDA has 18 members.



EPOXY impregnation= a better product...with J.P.DEVINE KNOW HOW

A rapidly increasing number of firms, both large and small, are turning to epoxy impregnation. They have learned the value of this new impregnant and its outstanding contribution to the electrical industry. They know that epoxies applied under correct vacuum and pressure produce a greatly improved product.

Epoxies offer the highest resistance to corrosion, the longest life and greatest insulation possible. And J. P. Devine, this country's pioneer firm in vacuum impregnating, can offer the high vacuum equipment plus the engineering skill and experience necessary to get the best possible epoxy impregnation.

Get in touch with J. P. Devine immediately to learn how an epoxy impregnation system can upgrade your product and how easily it can be installed in your plant.

Write for our new Catalogue No. 202, "Devine Vacuum Impregnators."

J. P. DEVINE MFG. CO. — A UNIT OF COX INDUSTRIES

49TH STREET & A. V. R. R. • PITTSBURGH, PA.

New York Office: 500 Fifth Ave., New York 36, N.Y. Phone: Wisconsin 7-7769; **Export Office:** 50 Church St., New York 7, N.Y. **Cable Address:** "Brosites"

Print Ins. 22 on Reader Service Card

New Publications

Books

Electronics and Nucleonics Dictionary, by Nelson M. Cooke and John Markus. More than 13,000 terms are defined. Correct usage, synonyms, and abbreviations are given. Included are many new words from the fields of space technology, magnetic-tape systems, guided missiles, underwater electronics, etc. 543 pages, 6" × 9", 452 illustrations and diagrams, $12. McGraw-Hill Book Co. Inc., 330 West 42nd St., New York 36.

Soviet Research in Boron Chemistry, compiled by D. R. Martin and F. J. Celli. A collection of 83 reports by leading Soviet scientists on research and development in the Soviet Union from 1949 to 1956. $40. Consultants Bureau Enterprises Inc., 227 West 17th St., New York 11.

Electronic Maintainability, edited by F. L. Ankenbrandt. Contains the full texts of the 29 technical papers discussed at the Third Conference on the Maintainability of Electronic Equipment held in December 1960. Hard cover, 6" × 9", 312 pages, $10. Engineering Publishers, Box 2, Elizabeth, N.J.

AIEE Publications

The following new publications have been issued by the American Institute of Electrical Engineers, 33 West 39th St., New York 18.

No. 79, *Capacitor Switches for A-C Distribution Systems*. 10 pages, 40 cents.

No. 81, *Measuring Ground Resistance and Potential Gradients in the Earth*. 18 pages, 70 cents.

No. 82, *Impulse Voltage Tests on Insulated Conductors*. 10 pages, 50 cents.

No. 83, *Radial Power Factor Tests on Insulating Tapes in Paper-Insulated Power Cable*. 4 pages, 50 cents.

No. 84, *Determining Tensile Strength and Hardness of Lead Sheaths*. 4 pages, 50 cents.

Military Electron Tubes (Appendix), Catalog No. D7.6/2:211/App. A, $1.25.

Tubes & Semi-conductor Devices, Catalog No. D7.10:200E, 25 cents.

Navy Contract Law, Catalog No. D201.5:C76, $8.

R.F. Characteristics, Catalog No. D7.10:449, 30 cents.

Navy Synchros—(Basic), Catalog No. Dx15.9:1303, 70 cents.

Electronic Circuits, Catalog No. D7/10:439A(WEP), $1.50.

Electron Tubes in Europe, Catalog No. C41.2:E12/5, 25 cents.

Electron Tubes in South America, Catalog No. C41.2:E12/7, 25 cents.

Tables of Dielectric Dispersion Data for Pure Liquids and Dilute Solutions. Catalog No. C13.4:589 (1958), 95 pages, 50 cents.

ASESA Information

The following bulletins merely provide information about action taken by the Armed Services Electro-Standards Agency, Fort Monmouth, N. J. Copies are not yet available.

JAN-S-23, Switches, Toggle (for Electronic and Communications Use). Notice 1 cancels JAN-S-23 and specifies that future procurement of these switches be made under MIL-S-3950A.

MIL-P-55110, Printed Wiring Boards. Supersedes XAR-153 (Bu-Aer) and MIL-P-21193 (Nord).

MIL-R-11C, Resistors, Fixed, Composition (Insulated). Notes that MS35350 and MS90194 are cancelled by revisions B and A, respectively.

MIL-R-5757D, Relays, Electrical (excluding thermal) for Electronic and Communication-Type Equipment. Supersedes MIL-R-5757C, MIL-R-21093A (SHIPS), and MIL-R-25018 (USAF) with several changes.

MIL-C-3608A, Connectors, Coaxial, Radio Frequency, Series BNC, and Associated Fittings, General Specification for. Revises MIL-C-3608 with several changes.

MIL-I-545A, Insulation, Electrical, Paper Pressboard. Supersedes JAN-I-545 and Army-Ordnance Missile Purchase Description 1511 with several changes.

This 24" diameter coil wound with 18 pounds of #.064x.130CCHEP rectangular magnet wire, is entirely self-supporting because it's made of Anaconda's new cement-coated epoxy magnet wire. The outstanding bond strength of this wire is stable at high temperatures, too, so coils can be removed from the oven and handled while still hot without danger of deforming.

new CEMENT COATED EPOXY magnet wire makes possible coils that hold their shape without support, hot (200 C) or cold

The secret's in the bond strength. Anaconda's new 130 C (Class B) cement-coated epoxy magnet wire forms a bond so strong that the coil is completely self-supporting.

No ties or braces are needed at any temperature up to 200 C. In fact, it can be removed from the oven at 200 C and dipped in encapsulating materials without losing its shape. Both ways you save on production costs.

The unique Anaconda epoxy cement coating softens just enough to bond each wire firmly to adjacent wires. The higher the temperature (to 200 C) the stronger the bond. It's a contact bond with minimum flow.

And the inherent dielectric properties and limited flow of the epoxy cement actually contribute to the electric strength of windings. Thus you can use cement-coated epoxy wire with little or no increase in overall diameter of the wire.

More advantages: Anaconda cement-coated epoxy magnet wire won't hydrolize in enclosed systems; it's completely compatible with standard transformer oils, varnishes, insulation and encapsulating materials; it's available in all sizes of round, square and rectangular, in spools, reels, pails or drums.

For more information about Anaconda cement-coated epoxy magnet wire, contact Anaconda Wire and Cable Company, 25 Broadway, New York 4, New York, Department EFL-1-I.

ASK THE MAN FROM

ANACONDA®

FOR CEMENT-COATED EPOXY MAGNET WIRE

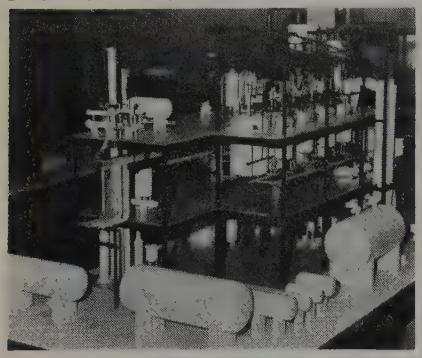
Print Ins. 24 on Reader Service Card

61271

Industry News

A new firm, *Intellux Inc.*, has been formed in Reseda, Calif., to specialize in thin film electronic techniques. Lewis W. Imm, former president and founder of *Librascope*, is president.

A plant (photo shows model) to produce "Ameripol" high density polyethylene by an improved version



of the Ziegler activated-catalyst system is being constructed at Port Neches, Texas, for *Goodrich-Gulf Chemicals Inc.*, Cleveland, Ohio.

Leach Corp., Compton, Calif., relay manufacturer, has purchased all the physical assets, including a 48 000 sq ft plant, formerly used by *U.S. Relay Co.*, a subsidiary of *Phillip Morris Co.*

Sutton Electronic Co., Lexington, Ky., a division of *Nytronics Inc.* since its inception in 1959, has become the *Automation Products Division*. It specializes in transformers and electromechanical assemblies.

The *Twin Coach Co.*, Buffalo, N.Y., has purchased the Body Div. of *York-Hoover Corp.*, York, Pa. The new subsidiary will produce electromechanical devices for utilities and other products as the *York Body and Equipment Co.*

Spectrol Electronics Corp., San Gabriel, Calif., a wholly-owned subsidiary of *Carrier Corp.*, Syracuse, N.Y., has purchased the *Bamford Corp.*, Santa Monica, Calif. Bamford's miniature square trimmer potentiometer manufacturing facilities will be moved to San Gabriel, where Spectrol manufactures a variety of electronic components.

A Government Contracts Dept. has been established by *Tri-Point Plastics Inc.*, Albertson, L.I., N.Y., "Teflon" plastic processor.

A multi-million dollar Technical Research Center in Granville, Ohio, has been completed by *Owens-Corning Fiberglas*, producer of fibrous glass products.

Spaulding Fibre Co., Tonawanda, N. Y., offers parts fabricated from Glastic polyester sheet stock, channels, and angles supplied by *The Glastic Corp.*, Cleveland, Ohio.

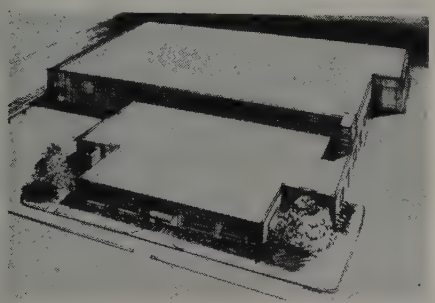
Spellman High Voltage Co. has moved to larger quarters at Bronx, N. Y., to meet the increased demand

for high voltage power supplies, coils, and transformers.

Phelps Dodge Copper Products Corp. has appointed *J. J. Glenn & Co.*, Chicago, as distributor of its magnet wire in Ohio, Wisconsin, Indiana, Iowa, and Illinois.

The Sprague Electric Co., North Adams, Mass., has acquired *Vec Trol Engineering Inc.*, Stamford, Conn., electrical/electronic control manufacturer. Vec Trol will be operated as a wholly-owned subsidiary with Walter J. Brown, its founder, continuing as president and chief engineer.

Armstrong Products Co., Warsaw, Ind., epoxy products producer, reports that its $100,000.00 expansion program is nearing completion. Included

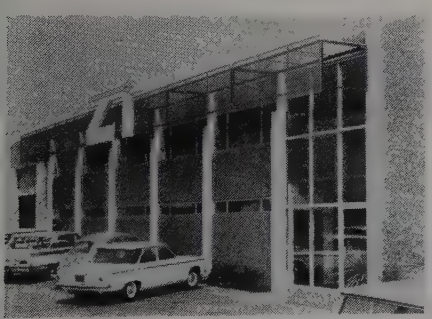


in the program is a new 5,000 sq ft factory building which will double production capacity.

Rogers Corp., Rogers, Conn., producer of plastic insulating materials, has named *Max Daggett Jr.*, Dallas, as sales representative in Texas, Oklahoma, and Louisiana.

At Pasadena, Cal., *Consolidated Electrodynamics Corp.*, a subsidiary of *Bell & Howell Co.*, has acquired the *Nuclear Div.* of *American Electronics Inc.*, Culver City. Financial details were not disclosed.

The Zippertubing Mfg. Co. has moved to new and larger quarters in



Los Angeles. The company also has opened a new warehouse and sales office in South Hackensack, N. J., with Jay Cooley, formerly of the Los Angeles sales office, in charge.

Construction of a modern research laboratory for *Rea Magnet Wire Co. Inc.*, Ft. Wayne, Ind., a division of *Aluminum Co. of America*, has been started. Present plans call for its occupancy in September, 1961. The laboratory will serve as technical center

for Rea customers, as well as housing four separate research departments, a development laboratory and pilot plant, and several supporting units.

Lenkhurt Electric, San Carlos, Cal., has licensed *VHM Corp.*, Oakland, Cal., to manufacture and market six different types of electronic test instruments and systems.

A $1.3-million expansion and modernization program at *Western Petrochemical Corp.'s* Chanute, Kan., refinery has been completed. The Chanute facilities are operated by Western's *Warwick Wax Div.* and provide high melting microcrystalline waxes.

Through mutual exchange of stock, the *Catalytic Combustion Corp.*, Detroit, has become a wholly-owned subsidiary of *Universal Oil Products Co.*, Des Plaines, Ill. The firm will continue to operate from its Detroit offices.

Flo-Tronics Inc., Minneapolis, has acquired *Rubber Industries Inc.*, Shakopee, Minn., and *Plastics Co.*, Minneapolis. The purchases have been approved by the company's board of directors, subject to approval by the stockholders. Also, the company's *Electronic Controls Div.* has moved into new facilities in Minneapolis.

Loren Patrick Associates, Alhambra, Cal., has been appointed sales representative for the West Coast by *Hull Corp.*, Hatboro, Pa., plastic processing equipment manufacturer.

Conap Inc., Olean, N. Y., reports it is equipped to evaluate materials and components according to the requirements of most military specifications, with special emphasis on environmental testing.

DataMation Inc., Los Angeles, has been acquired by *Missile Systems Corp.*, North Hollywood, Cal. DataMation is engaged in data reduction, procesing, and documentation for the missile and space age industries.

The *Polytechnic Institute of Brooklyn* spent $3,412,986 on research in science and engineering in the last fiscal year. An increase of 6.8 percent over the previous year's expenditures, the research budget is the highest in the institute's history.

Paraplegics Mfg. Co. Inc. has moved its offices and manufacturing

facilities to new and larger quarters in Bensenville, Ill.

T. Kennedy Co., Wakefield, Mass., has been named engineering sales representative in the New England states for *National Connector Corp.*

The Borden Co. and the *United States Rubber Co.* have jointly acquired a site in the greater Baton Rouge, La., area for the construction of a $50,000,000 complex of chemical plants. The new chemical company, to be called *Monochem Inc.*, will have the capacity to produce more than 80-million pounds of acetylene and approximately 150-million pounds of vinyl chloride monomer yearly. The major initial use of this plant's output would be in the manufacture of vinyl plastic resins. The plants are scheduled for completion in 1962.

Physics Research Laboratories, Hempstead, N. Y., has been appointed American representative of *C. P. Goerz, Otto Wolf*, and similar instrument firms of Europe.

Increase of manufacturing facilities and personnel by *Tri-Point Plastics Inc.*, Albertson, L. I., N. Y., plastics manufacturer, includes a 10,000 sq ft plant in Albertson.

Chase & Sons Inc., North Quincy, Mass., has appointed *J. F. Postell Co.*, Cranfield, N. J., as sales representative for New Jersey and surrounding counties in Pennsylvania and New York.

Better Refrigerant-22 resistance with new Formvar/based enamel

A new FORMVAR based magnet wire enamel has been developed specifically for hermetic as well as general purpose service. The new insulation offers excellent resistance to Refrigerant-22 . . . extractibles ½% or below. Also, it offers high cut-thru resistance . . . up to 300°C. Plus the same service-proven balance of properties of standard FORMVAR-with-phenolic enamels.

Consider this unequalled combination of key properties:

- Refrigerant-22 extractible content below ½%; excellent blister resistance before and after prebake.
- Excellent moisture resistance as determined by the boiling water test.
- Wet dielectric strength greater than 2000 volts per mil after 24 hour submersion in distilled water.
- Electrical resistance retained at elevated temperatures.
- Thermal life of 60,000 to 100,000 hours at 130°C when overcoated with suitable varnishes.

This new enamel has been well proved in the field. The enamel or coated wire is available from your regular supplier under the FORMETIC or other trademark. Consult him for more details on how this new insulation will pay you real dividends in trouble-free performance.

SALES OFFICES: ATLANTA CHICAGO LOS ANGELES NEW YORK CLEVELAND SAN FRANCISCO GREENSBORO ST. LOUIS

IN ENGLAND & EUROPE: SHAWINIGAN LTD., MARLOW HOUSE LLOYD'S AVENUE, LONDON, E. C. 3

FORMVAR®
polyvinyl formal by
SHAWINIGAN RESINS

Print Ins. 28 on Reader Service Card

People in the News

Robert E. Attig has joined Shawinigan Resins Corp., Springfield, Mass., as a sales trainee.

Roy W. Pyburn has been named assistant to the president of Data-Control Systems Inc., Danbury, Conn.

George L. Downs has been named manager of the Minuteman program office at the Amherst Laboratories of Sylvania Electric Products Inc.

Col. Robert F. Frost, USAF ret., has been named to the staff of the new National Electronics Facilities Organization Inc., Garden City, N. Y. *Robert J. Seymour* has been named assistant to executive vice president *Phillip H. Goodwin.*

Mark V. Goodyear has joined Conap Inc., Olean, N. Y., research firm, as manager of chemical development.

Henry J. Lang has been appointed to the western Pennsylvania-West Virginia area sales district for Acheson Colloids Co., Port Huron, Mich.

Allied Control Co. Inc., New York City, has elected *Armand T. Audette* to vice president for manufacturing and *August C. Kircher* to vice president in charge of design and development.

Herbert R. Reiss has been named manager of the New Rochelle, N. Y., plant of Precision Circuits Inc., producer of printed wiring boards.

Dr. George M. Anderson has been named president of the Thomas A. Edison Research Laboratories of the McGraw-Edison Co., West Orange, N. J.

James R. Weiner has been named vice president, engineering, for Philco Corp.'s Government and Industrial Group, Philadelphia. At Willow Grove, Pa., *Dr. Louis R. Lavine* has been named manager, programming research and development, for the Computer Div., Government and Industrial Group.

Rogers Corp., Rogers, Conn., plastics producer, has named *Jerrold J. Abell* as development engineer. The firm has named the following sales representatives: *Frank P. Welsh* in Baltimore, *Albert M. Ankrom* in St. Louis, and *Robert E. Sanders* in northern Ohio.

Kenneth C. Hayes has been named manager, technical service department, American Machine & Foundry Co.'s Research and Development Div., New York.

Thomas T. Arden, president of the Robertshaw-Fulton Controls Co., has been named chairman of the National Corporations Committee for the Freedoms Foundation at Valley Forge, Pa.

Philip Kootman has been appointed president of PRL Electronics Inc., Rahway, N. J., test equipment manufacturer.

P. Kootman

D. P. Ebaugh

David P. Ebaugh has been named chief of the industrial engineering department, Automation Product Div., Nytronics Inc., Lexington, Ky.

Lincoln S. Love has joined the Panelyte Div., St. Regis Paper Co., as coordinator of defense projects at the division's five plastics processing plants.

At Philadelphia, Philco Corp.'s Government and Industrial Group has appointed Maj. Gen. *Raymond C. Maude* as director of field operations.

A. Lawrence Karp, previously with the NJE Corp. and Allen B. DuMont Labs., has been appointed sales manager of PRL Electronics Inc., Rahway, N. J.

David W. True has joined Shawinigan Resins Corp., Springfield, Mass., as a sales trainee.

Leon A. Menzl, Jr., formerly with The Burndy Corp., has joined American Machine and Foundry Co., New York City, in the newly created position of procurement administrator. *Charles S. Hazard*, formerly with Republic Aviation Corp., has been named manufacturing specialist, also

DAPON® RESIN STOPS ARCING DUE TO MOISTURE

DIALLYL PHTHALATE

ARK-trol connector can be disconnected while carrying full current loads—DAPON has high arc and tracking resistance even after moisture conditioning.

If you require outstanding electrical properties in a resin, tear a leaf from the design book of Crouse/Hinds Company, Syracuse, N. Y. At the heart of their new ARK-trol connector series, you'll find molded parts of DAPON resin. By using DAPON, they—

- Overcome the problem of contact misalignment due to post-mold shrinkage of other plastics.
- Eliminate the severe drop in resistivity under moist conditions, characteristic of other plastics.
- Utilize excellent electrical properties to reduce insulating material by approximately 50% without lowering previous electrical ratings.

DAPON molds easily around metal inserts without corrosion. With DAPON there's virtually no shrinkage or cracking after molding (connector pins remain tight!). The material has extremely low moisture absorption—it maintains high arc resistance even in moist atmospheres.

DAPON diallyl phthalate resin withstands extremes of temperature, vibration and shock. The tolerances of DAPON parts are practically unaffected by long-term operation at temperatures up to 450°F.

Specify DAPON (diallyl phthalate) Resin when you need:

- Low dielectric loss
- High dielectric strength
- Superior dimensional stability
- Excellent arc resistance
- High volume and surface resistance after high humidity-high temperature conditioning.

Write today for literature covering technical aspects and uses of this rugged thermosetting resin and the names of compounders using DAPON Resins.

Putting ideas to work

FOOD MACHINERY AND CHEMICAL CORPORATION

Dapon Department
161 East 42nd Street, New York 17, New York

Print Ins. 30 on Reader Service Card

a newly created position.

David L. Leonard has been assigned as a technical representative in the Metropolitan New York sales region of Union Carbide Plastics Co.

At Narda Microwave Corp., Mineola, L. I., N. Y., *Howard S. Bertan*, manager of the High Power Electronics Div., has assumed additional responsibilities as group leader for the Electronic Products Div. *Adolph Brenner* has been appointed senior microwave engineer, and *Donald Elkort* has been named group leader for ferrite devices.

Carroll J. Peirce has joined the office of the chief engineer at Goodyear Aircraft Corp., Akron, Ohio. He has served as a consultant on European research and development for the U. S. State Department, several aeronautical firms, and as a vice president for The Rand Development Corp. *Charles D. Conner* has joined the firm's computer engineering department as a development engineer, and *Brenton R. Groves*, an engineering specialist, has been assigned responsibilities in the firm's training and test equipment engineering department.

David H. Thomas has been named president of Rotax Inc., newly formed manufacturer of precision hysteresis synchronous electric motors in West Los Angeles. He had been founder and president of Air Marine Motors Inc., Amityville, N. Y.

H. Kenneth Foute has been elected president of Drake Manufacturing Co., Chicago; *Jack Krutek*, former secretary and sales manager, has been elected vice president in charge of sales; and *Melvin Klingenberg* has been named secretary.

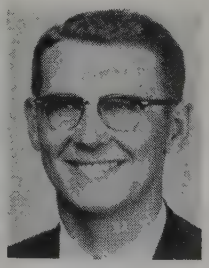
Dr. Robert Carbone has joined the Central Electronic Manufacturers Div., Nuclear Corp. of America, Denville, N. J., as director of the Plasma Physics Laboratory.

Synthane Corp., Oaks, Pa. manufacturer of industrial laminated plastics, has added *Thomas C. Muench* to its New York district sales staff to cover Northern Connecticut.

Jerre W. Hoffman, formerly product supervisor in technical industrial sales, has been named to the newly created post of Electrical Paper Specialist for the Specialty Products Div., Riegel Paper Corp., New York City.

Elgin National Watch Co. has appointed *E. C. Spevak* as engineering manager of the firm's Electronics Div., Burbank, Cal.

E. C. Spevak



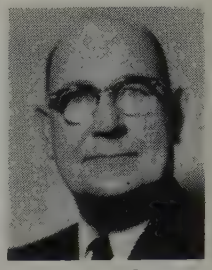
Lang Gilbert

Lang Gilbert, with the company since 1956, has been named Eastern sales representative for Board Products, West Virginia Pulp and Paper, Covington, Va.

At Waltham, Mass., Sylvania Electric Products Inc., a subsidiary of General Telephone & Electronics Corp., has announced the promotion of *Dr. Seymour Stein* and *Dr. James E. Storer* of the company's Applied Research Laboratory, to senior scientist.

James J. Phelan, with the company since 1940, has been promoted from assistant purchasing agent to purchasing agent of The Thomas & Betts Co., Elizabeth, N. J.

J. J. Phelan



Les A. Thayer

Les A. Thayer of Belden Manufacturing Co., Chicago, has been elected vice president, sales. With the firm for 30 years, he has been active in the electronic and automotive trade associations and is currently president of the Automotive Service Industry Association.

At Pasadena, Cal., *Dr. Charles F. Robinson*, director of the Bell & Howell Research Center, has been elected vice president of Consolidated Electrodynamics Corp., a subsidiary of Bell & Howell. He joined the company in 1947. *Robert A. Hall*, formerly administrative manager of CEC's Datalab Div., has been named manager of the newly established separate connector department within the Electro Mechanical Instrument Div. At Monrovia, *George G. Brooks* has been appointed director and *John C. Alrich* assistant director of industrial systems at Consolidated Systems Corp., an associate company of Allis-Chalmers, Bell & Howell, and Consolidated Electrodynamics.

The Blane Corp., Canton, Mass., has appointed *Martin M. Stekert* as sales representative in the New York area.

A. Maslin, AMP Inc., has been appointed product sales manager for the company's AMPin-cert printed circuit edge connector line at headquarters in Harrisburg, Pa.

Oak Manufacturing Co., Chicago, has announced the following appointments: *L. H. Flocken*, with the company since 1935, to product manager, switches; *Paul W. Wheaton*, with the company for 20 years, to product manager, TV and radio tuners; and *William J. Cole*, with Oak for eight

Outstanding new Formvar-type wire specifically for hermetic motors using R-22 . . .

PHELPS DODGE HERMETEZE®

- Excellent resistance to softening and extraction by R-22 and R-12 refrigerants.
- Exceptional resistance to all conventional solvents.
- Outstanding ability to take heat and pressure without excessive physical softening—provides maximum protection against short time, high overload stress on windings.
- Excellent chemical stability—good resistance to hydrolysis.
- Retains flexibility in hot oil.
- Retains dielectric at operating temperature.
- No sacrifice of physical or electrical properties over hermetic Formvar.

Hermeteze is Phelps Dodge's new Vinyl Formal-Urethane magnet wire for hermetic motors operating in R-22 and R-12 refrigerant gases and oil. It represents a major advance in film wire insulation designed for hermetic unit operation. In addition to having all the excellent physical, chemical and electrical properties of Formvar, Hermeteze offers remarkably improved properties for protecting windings against failure from plastic flow at overload conditions.

Any time your problem is magnet wire, consult Phelps Dodge for the quickest, surest answer!

Formvar®-Shawinigan Resins

FIRST FOR LASTING QUALITY— FROM MINE TO MARKET!

PHELPS DODGE COPPER PRODUCTS CORPORATION

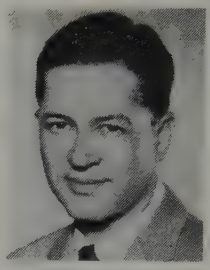
INCA MANUFACTURING DIVISION

FORT WAYNE, INDIANA

Print Ins. 31 on Reader Service Card

years, to product manager, special and government products. *Howard O. Olson* has been named assistant product manager, rotary solenoids, vibrators and choppers; *Heinz J. Kuhlman,* assistant product manager, appliance controls; and *R. J. Wlochall,* assistant manager, switches.

Henry C. Jones, former executive vice president and director of operations for The Electrada Corp., Los Angeles, has been elected president and a director.



H. C. Jones

J. P. Jacobic

John P. Jacobic has been appointed quality control manager of the ESC Electronics Corp., Palisades Park, N. J.

Roger M. Daugherty has been named general manager of the new Farmingdale, N. J. plant of Reeves Instrument Corp.

Hull Corp., Hatboro, Pa., has appointed *Robert F. Zecher* district sales manager for Eastern Pennsylvania, Southern New Jersey, Maryland, Delaware, Washington, D. C., Virginia and Eastern West Virginia.

The appointment of *Jack W. McCarthy* as vice-president in charge of manufacturing, has been announced by Electronic Transistors Corp., North Bergen, N. J.

J. W. McCarthy

G. J. Landers

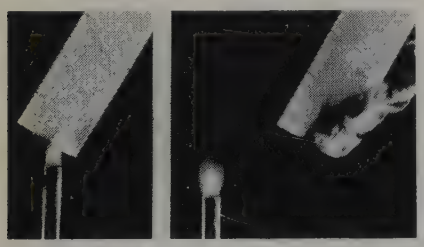
Gunther J. Landers has joined Crousse-Hinds Co., Syracuse, N. Y., as product development manager. He was formerly associated with Construction Equipment Div., Blaw-Knox Co.; New York Air Brake Co.; and Westinghouse Electric Corp.

New Products

For further information on these products print the item number on the Reader Service Inquiry Card on the back cover. Fill out and mail the card—no postage is required. Insulation *will immediately forward your inquiry to the manufacturers concerned so that they can send you more information promptly.*

Two New Laminates for TV, Radio, and Computer Circuitry

Two new grades of fire-retardant industrial laminates include a glass-epoxy laminate, designated FF-93FR which is said to combine rapid self-extinguishing qualities with excellent electrical and machining properties. It was developed to minimize the hazard of fires caused by high voltages in computer circuitry applications. The second new grade, designated XXXP-100FR, is a paper-base phenolic laminate for radio and TV chassis boards which require flame-retardant and cold-punching properties. At 150°C, 1/16″-thick FF-93FR reportedly extinguishes after 3 secs by NEMA's modification of the ASTM D-635 ignition test. The grade is available with copper-clad or un-clad finishes and close thickness tolerances. Strength, dimensional stability, and electrical properties are stated to remain high under adverse moisture conditions. Burn times of XXXP-100FR are claimed to be under 5 secs in the NEMA modifications of the ASTM D-635 tests. Formica Corp., a subsidiary of American Cyanamid Co., 4614 Spring Grove Ave., Cincinnati 32. Ohio.



Print No. Ins. 101 on Reader Service Card

Class H Silicone Varnish Cures at 150°C

A new class H varnish is said to cure at 150°C in just 6 hrs. Designated 981 varnish, the new material is as easy to process as most class A and B varnishes, and eliminates the need for high-temperature curing ovens in producing class H electrical equipment. The new dipping and impregnating varnish meets AIEE requirements for both 180°C and 220°C systems. Extensive tests reportedly indicate that despite the lower curing temperature—50°C below that required for most other silicone varnishes—981 varnish has greater heat stability than any other varnish known. Run-off is also claimed to be substantially lower than that of other varnishes. It is expected to be especially suited for impregnating such large electric equipment as transformers of 500 kva or larger, traction motor armatures, motors, and generators. The new varnish is also stated to provide complete impregnation and trouble-free curing for the fine magnet wire coils of electronic transformers and servo-motors. Dept. CS-149, Dow Corning Corp., Midland, Mich.

Print No. Ins. 102 on Reader Service Card

Asbestos-Polyvinyl Acetate Paper

A new form of highly purified, inorganic fiber paper saturated with polyvinyl acetate, style No. 7504, is a combination of glass cloth and a long-fibered asbestos paper with unusually fine and uniform texture. Based upon a gauge of .010 inch, the paper weighs 27 lbs/100 sq yds. The paper base sheet is a composition of 35% asbestos fibers and 65% glass fibers. Tensile per 1″ width is 45 lbs lengthwise. Average tear strength is 100 grams machine direction, over 350 grams cross machine direction. Asbestos Textile Div., Raybestos-Manhattan Inc., Manheim, Pa.

Print No. Ins. 103 on Reader Service Card

Low Viscosity, Flexibilizing Epoxy Curing Agent

"Leecure" A is a new organic acid type hardener which is said to offer a combination of outstanding properties when formulated into epoxy resin systems. It is stated to be readily compatible at room temperature with all liquid epoxy resins and to give low viscosity, easily pourable systems even when fillers are used. Other features are long pot-life and comparatively low toxicity level. Only moderate heating is required to yield flexible to tough, hard plastics, when used alone or in combination with other anhydride hardeners. Excellent electrical, thermal, and adhesive properties reported—even to "Mylar", Nylon, and RTV silicones—make it especially suited for potting, impregnating, encapsulating, and adhesive applications. Technical data, formulations, and price information available. Leepoxy Plastics Co., Dawkins Rd., New Haven, Ind.

Print No. Ins. 104 on Reader Service Card

Hot Punching Laminate with Low Cold Flow Properties

A new hot punching laminate exceeds XXXP requirements and has specially formulated high insulation and low cold flow properties. Grade 825 can be utilized in severe jack spacer applications because of its superior cold flow characteristics. Typical electrical properties claimed for 1/16″ thickness are: dielectric strength, perpendicular, S/T—650; V/M dielectric strength, parallel, S/S, A—70; kv dielectric strength, parallel, S/S, D48/50—20; kv dielectric constant, D 24/23—48; power factor, A—.032; power factor, D 24/23—.033; insulation resistance, C 96/35/-90—375,000 megohms. Samples available. Dept. WMG, Panelyte Div., St. Regis Paper Co., Trenton 8, N. J.

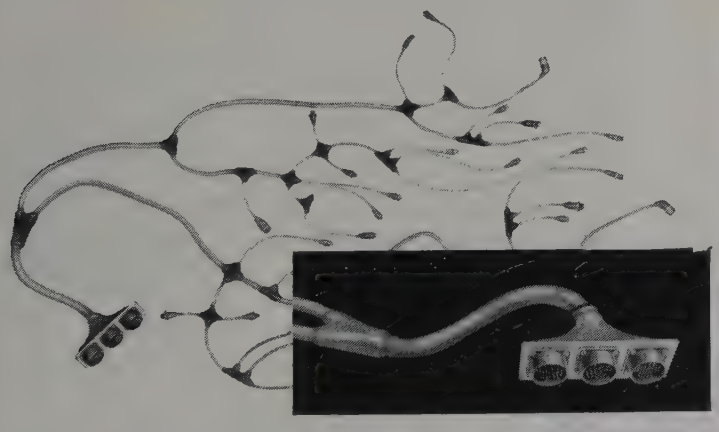
Print No. Ins. 105 on Reader Service Card

Improved Liquid Anhydride For Curing Epoxy Resins

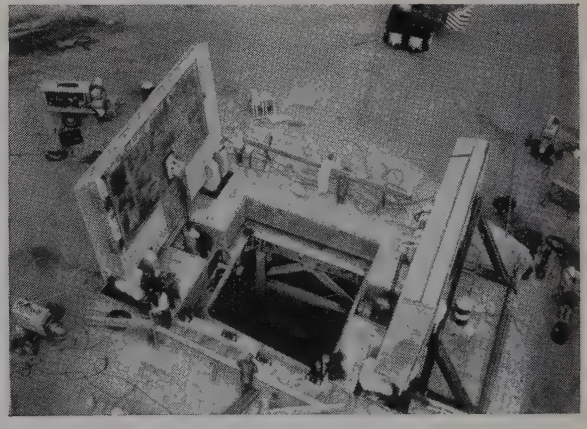
A new liquid anhydride is said to have improved properties in numerous applications, particularly in curing epoxy resins. With epoxy resins, "Alkendic" anhydride reportedly provides long pot lives, ease of mixing, lower density, and very low vapor pressures during cure, thereby reducing material losses. Cured products are claimed to have high heat distor-

General Electric Silicone Rubber helps get Titan ICBM combat-ready

Missile and ground-support applications are "naturals" for the unique qualities of silicone rubber—heat resistance above 600°F, low-temperature flexibility to −150°F, good thermal conductivity, unexcelled ozone resistance and virtually unlimited life under normal conditions. Because it retains its excellent electrical properties over a wide temperature range, G-E silicone rubber is also used for missile wire and cable insulation. Even when continuously exposed to direct flame, it forms a non-conducting ash which gives off no toxic fumes.



Missile wiring harness — General Electric silicone rubber was chosen by Aerojet-General Corp. for the Titan's propulsion system wiring harness. Breakouts and junctions are molded from G-E RTV (room temperature vulcanizing) silicone rubber; wiring is silicone insulated; jacketing is high-strength G-E silicone rubber. Inset shows silicone rubber inserts in connectors. RTV is used in other missiles as a shock-absorbing encapsulant and potting material for electronic assemblies.



200 tons of steel and concrete — Titan missile silo doors by American Machine & Foundry Co. use seals of G-E silicone rubber. AMF also used G-E silicone rubber door seals on the Titan's ground support entry portals and radar silos. Silicone rubber can withstand the heat of rocket blast-off or possible atomic attack while remaining stable in storage for long periods.

Write for more information on G-E silicone rubber, briefly describing your application. Section M234, Silicone Products Department, Waterford, New York.

GENERAL ELECTRIC

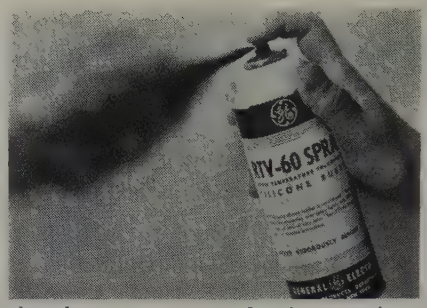
Print Ins. 35 on Reader Service Card

tion temperatures, exceptionally low shrinkage, and good aging characteristics at elevated temperatures, indicating wide utility in electronic component encapsulation and potting. Alkendic anhydride is also suggested for use in alkyd resins, plasticizers, and rust-inhibiting compounds, as well as an intermediate in chemical reactions. Especially notable are its low viscosity, good compatibility with other chemicals, and outstanding resistance to hydrolysis by atmospheric moisture. Amchem Products Inc., Ambler, Pa.

Print No. Ins. 106 on Reader Service Card

Liquid Silicone Rubber Insulation in Aerosol Cans

A liquid RTV (room temperature vulcanizing) silicone rubber in aerosol spray form shows promise for applying a thin, uniform encapsulating coating on electronic assemblies and parts as well as a spray coating for easy release of molded plastic parts. Other uses are developing in maintenance and other applications where thin, thermal, protective, shock



absorbant, or nonconductive coatings are desired. The red liquid silicone rubber (RTV-60) in aerosol spray form is said to possess all of the desirable properties of conventional liquid silicone rubber. It reportedly has good physical and electrical properties and resists temperatures from —65°F to 600°F (—53.9°C to 316°C), resists many solvents, is unaffected by ozone, has its own "built in" release agent, and exhibits good bonding ability. Cure time varies from 15 minutes to several hours depending on amount and type of catalyst used. RTV-60 spray is applied directly to the desired surface. Cure is obtained by spraying a curing agent on the RTV coating. Where bonding is required, a primer is used. Silicone Products Dept., General Electric Co., Waterford, N. Y.

Print No. Ins. 107 on Reader Service Card

Self-Extinguishing Epoxy Resins

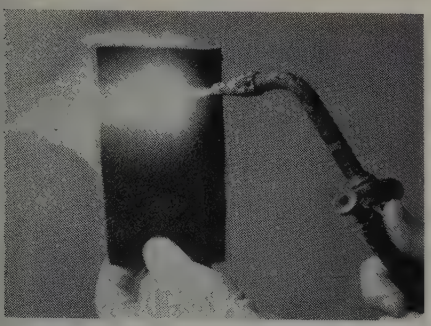
Two experimental epoxy resins, X-3442 and X-3441.1, are made self-extinguishing through halogen—bromine — substituted on the epoxy molecule. They are cured or hardened with the common epoxy curing agents. The self-extinguishing epoxy resins should find use in laminated aircraft structures, glass and paper-based laminated electrical circuits, filled castings, in aircraft and missile adhesives, and in sheath coatings (for solid or foamed plastics). Experimental resin X-3442 is a semi-solid containing about 49% bromine and has utility in blends with conventional liquid epoxy resins. Experimental resin X-3441.1 is a solid resin containing about 19% bromine and can be used either alone or in blends with conventional solid resins. A bromine content of 15-25% is said to make even clear castings self-extinguishing. Physical and electrical properties of casting and

laminates made with the new resins reportedly are comparable to properties developed by conventional epoxy resins. Dow Chemical Co., Midland, Mich.

Print No. Ins. 108 on Reader Service Card

Organic Fiber for Fabric and Reinforcement Resists 18,000°F

An all-organic, heat-resistant fiber is said to retain its flexibility and part of its strength after exposure to intense heat (withstands 18,000°F



without melting). Called "Pluton" brand heat-resistant fiber, it is available as a fabric but also can be worked into laminates reinforced with high-temperature phenolic resin to form structural parts or molding compounds. The fiber is claimed to be entirely free of elemental carbon and to conduct very little heat or electricity. It reportedly does not char or melt. Potential uses for the fabric are missile motor case liners, and anti-arc wraps in electrical power plants. In the form of a laminate, approximately 50-50 combination with phenolic resin, the fiber is suitable for structural parts such as missile nose cones and is being used in tests of rocket engine parts. Minnesota Mining and Manufacturing Co., 900 Bush Ave., St. Paul 6, Minn.

Print No. Ins. 109 on Reader Service Card

Epoxy Adhesive for Mounting Junction Boxes

PA-1041 epoxy resin for adhering electrical junction boxes to masonry walls, ceilings, and floors; metal beams; and wood surfaces is a two-part (epoxy resin-hardener) material packaged in a separator type cup which is the mixing container. It is stated to be waterproof, weatherproof, resistant to acids and alkalis, solvent-free, non-toxic, and non-dermatitic. Eight to 10 boxes reportedly can be coated and mounted in less than 15 minutes. After applying the adhesive the box is merely pressed into place and held for about 5 seconds to allow initial tack. When fully cured (about 3 hrs) the bond strength is claimed to be stronger than the strength of a masonry wall. Each cup unit will do 8 to 10 4″ x 4″ junction boxes. Cups are packaged 8 per display box along with abrasive for roughing up box surface, stirrers, and instruction sheet. Permacel. New Brunswick, N. J.

Print No. Ins. 110 on Reader Service Card

Glass-Phenolic Molding Material For Critical Electrical Uses

A new high temperature molding material is intended for critical insulation applications such as in connectors and coil forms. The material, RX 600, is a glass reinforced phenolic which is claimed to offer superior electrical properties in the presence of moisture, in addition to excellent heat resistance, dimensional stability, and flame resistance. It molds at extremely

low pressure and reportedly can be used without difficulty in all types of automatic equipment. Some of the material's molded properties reported are: Heat resistance, continuous, over 450°F (232°C); flame resistance, ignition time, 350 secs avg, burning time, 45 secs avg; dimensional change after thermal cycling, in/in, .0005 max; dielecrtic constant, 1 MC, 4.53 avg; and arc resistance, 184 secs avg. Rogers Corp., Rogers, Conn.

Print No. Ins. 111 on Reader Service Card

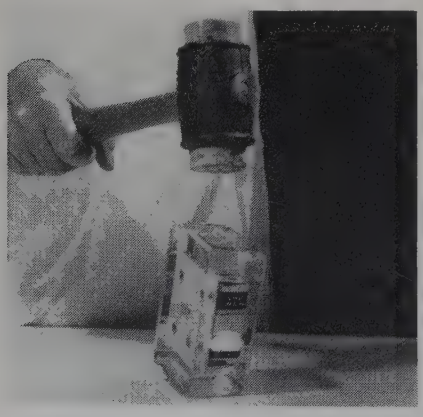
Adhesives Improve Heat Resistance and Strength of Flexible Composites

New adhesives and saturants reportedly improve thermal resistance, tensile strength, and resistance to strong solvents in flexible composites. "Mylar" and rag paper laminates made with EL-20 adhesive are said to withstand heating for 96 hrs at 125°C, as well as 1 hr at 125°C followed immediately by 3 hrs at 175°C, without delamination or loss of ply adhesion. Mylar and "Quinorgo" laminates with EL-5B are claimed to withstand 96 hrs at 125°C and to resist the effects of strong solvents. "Dacron" and Mylar composites with 50%, 70%, and 100% saturation are stated to show improved tensile strength and heat resistance for 96 hrs at 135°C. Data sheets and samples available. Arvey Corp., 300 Communipaw Ave., Jersey City 4, N. J.

Print No. Ins. 112 on Reader Service Card

Clear, Flexible Silicone Potting Material for Electronic Assemblies

A new clear silicone potting and embedding compound that provides mechanical and dielectric protection for electronic components and assemblies, LTV 602 (low temperature vulcanizing), cures at 70 to 80°C to a flexible, resilient solid. LTV 602 reportedly provides excellent protection against shock, vibration, moisture, ozone, corona, and other environmental hazards of the space age. Unlike jelly-like potting compounds, the cured material is self-supporting and non-flowing. Components embedded in the material can be readily identified, repaired, or replaced by removal of a section with a sharp instrument. New material can be poured into the cutout section and is claimed to cure without leaving evidence of repair. Silicone Products Dept., General Electric Co., Waterford, N. Y.



Print No. Ins. 113 on Reader Service Card

Flame Retardant Phenolic Laminates for Printed Circuits

Two new XXXP flame retardant phenolic laminates, grades 833 (unclad) and 8334 (copper foil surface), are said to be particularly suited as insulating bases for many printed circuit applications previously demanding the use of the more expensive epoxy paper laminates. For general use, they are suitable where flame retardancy is required in addition to high quality XXXP properties. Use of these laminates as a substitute for epoxy resin reportedly is possible because of their excellent dielectric properties, ease of processing, and flame retardancy. Typical properties claimed for grade 833 are: dissipation factor, A—.032, D24/23—.034; dielectric constant, A—4.5, D24/23—4.6; water absorption—0.5%; surface resistance, C96/35/90—100,000 megohms; and self-extinguishing by ASTM D 635. One oz copper foil clad 8334 is stated to have 8 lbs/in peel strength and to withstand blistering for 8 sec at 500°F solder temperature. Samples available. Dept. WMG, Panelyte Div., St. Regis Paper Co., Trenton 8, N. J.

Print No. Ins. 114 on Reader Service Card

Fast Acting Epoxy Stripper

New "Isochemstrip" 708 is said to be a thixotropic dip that clings to resin and disintegrates the resin at a high rate of speed, has exceptional low volatility, and has no detrimental effect on metal leads or components. It may also be painted on epoxy coated surfaces—usually 5 to 10 minutes soak are enough to remove the epoxy. Isochem Resins Co., 221 Oak St., Providence 9, R. I.

Print No. Ins. 115 on Reader Service Card

Closed Cell Sponge for Electronic Applications

New closed cell "Viton" and "Fluorel" sponge features extremely small and uniform cell size. The foam product reportedly has all the chemical resistance of the standard fluorinated polymer from which it is made. Because of the expanded structure, the material compares in hardness to a very soft rubber of about 20 Durometer (Shore A). The foamed version has approximately one-fourth the density of the solid product which permits a wide range of compressibility in such applications as gaskets and mountings. The high temperature properties, vibration damping qualities, excellent dielectric strength and acid resistance reported suggest many other applications in the electronics, missile, and automotive industries. Industrial Electronic Rubber Co., 31945 Aurora Rd., Solon 39, Ohio.

Print No. Ins. 116 on Reader Service Card

Weather-Proof Electrical Tape

A new weather-proof plastic electrical tape is stated to be unaffected by acids, alkalies, or oils. C-300 plastic electrical tape has a black vinyl film backing and low creep pressure-sensitive adhesive. The ¾" wide tape is packaged in 66 ft lengths in a convenient metal container, and is recommended for insulating electrical connections of all types. Only .007" thick, it reportedly has a tensile strength of 25 lbs/in width and 150% minimum elongation. Insulation resistance of 500,000 megohms, an electrolytic corrosion factor of 1.0, power factor of .07 at 60 cycles and .03 at 106 cycles, and a dielectric constant of 3.2 at 60 cycles and 2.3 at 106 cycles are claimed. Arno Adhesive Tapes Inc., Michigan City, Ind.

Print No. Ins. 117 on Reader Service Card

Molding, Bonding, Filling Compound With Good Electrical Resistance

A new molding, bonding, filling, and shape-making compound is said to have outstanding electrical resist-

New "Taylorite"® is a veritable workhorse

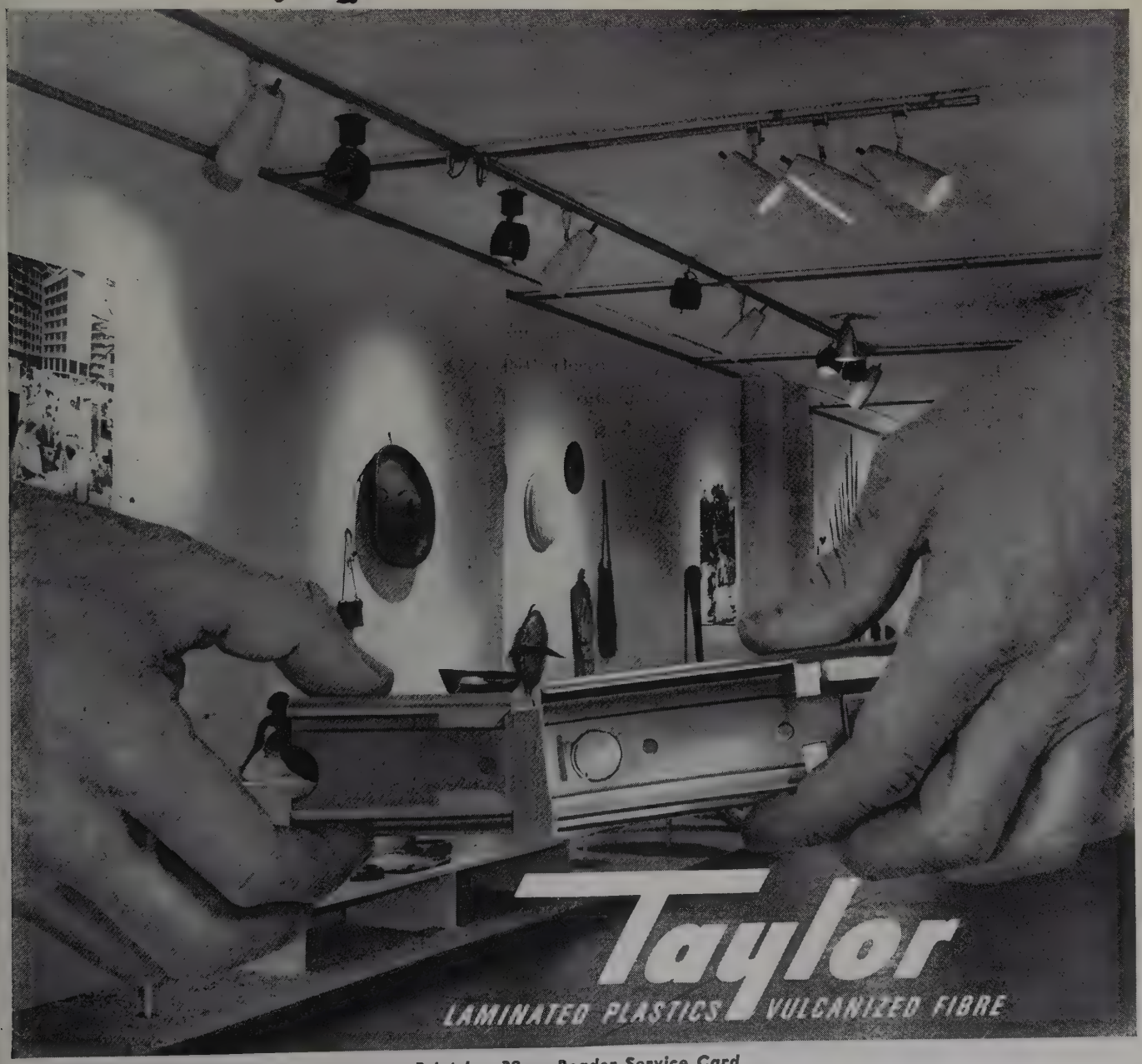
Background photo courtesy Philadelphia Commercial Museum. Lighting Duct courtesy BullDog Electric Products Division, I-T-E Circuit Breaker Co.

Improved Vulcanized Fibre... superior insulation, excellent forming characteristics

Dramatic highlighting of displays at the Philadelphia Commercial Museum is accomplished quickly and inexpensively with BullDog Universal Lighting Duct.® Fixtures can be added, moved and relocated anywhere along the duct run in a matter of minutes. Contributing to the effectiveness and safety of this modern lighting system is the formed Taylorite vulcanized fibre part used to insulate the conductors from the end caps. Taylorite was selected because it provides superior insulation, has excellent forming characteristics, provides good dimensional stability. Taylorite is ideal for the fabrication of many mechanical components, too. Its high impact resistance, flexibility, formability, toughness and capacity to be deep drawn make it adaptable to 1001 industrial applications.

Samples are available. Test them for yourself. Put them under tension, flex them, compress them, form them. You will find that new Taylorite will pass your severest tests with flying colors. And remember, Taylor offers complete design and engineering assistance.

Write for Data Sheet 2-0 and samples. Taylor Fibre Co., Norristown 51, Pa.



Print Ins. 39 on Reader Service Card

ance. The product is also claimed to be resistant to acid, alkali, grease, and solvents; to be non-shrinking and non-crumbling; to have controllable curing; and to hold its shape. Free "Desk-Test" kit available. Future Chemicals, 4350 N. Whipple St., Chicago 18.

Print No. Ins. 118 on Reader Service Card

Epoxy Adhesive Kit for Difficult Bonding Problem

Mounting of junction boxes and other difficult bonding problems reportedly can be solved with a new "Twinweld" epoxy 'Tach-Kit. Mixing is simple. Equal amounts of resin and hardener are claimed to result in a bond that resists acid, alkali, grease, solvents, and weather. The material is also said to be impact resistant and non-shrinking. Pocket-size kit is priced at $1. Samples available. Fybrglas Industries, Dept. K, 3010 W. Montrose Ave., Chicago 18.

Print No. Ins. 119 on Reader Service Card

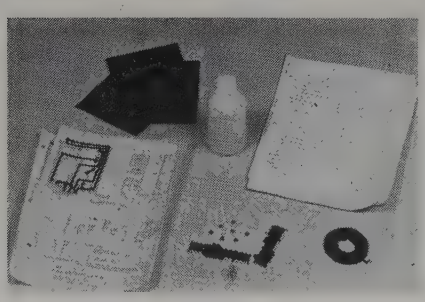
Hook-Up Wire for Use to 1000°F

A new mica and silicone-glass lead wire that is still experimental is said to be capable of reliable operation up to 1000°F (538°C). Known as "Tetralene" type MGT, the wire has been subjected to extensive heat-cycle tests without destruction to the insulation. It reportedly has also been determined that the wire will maintain a minimum dielectric strength of 1000 v, has been successfully spark-tested at 2000 v, maintains insulation resistance above 10,000 megohms, and has more than satisfactory flexibility. American Super-Temperature Wires Inc., West Canal St., Winooski, Vt.

Print No. Ins. 120 on Reader Service Card

Printed Circuit Kit

Printed circuits can be made right at the design desk with new "Quik-Cirkits." Each kit contains complete instructions and enough materials—

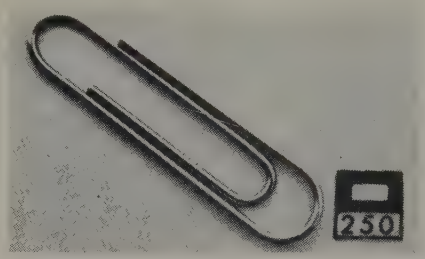


copper clad board, liquid chemical etch, etch resistant terminal pads, and etch resistant tape—to make three printed wiring boards. A plastic etchant tray is also included. Price is $5 per kit. Advanced Designs Inc., 914 Lullaby Lane, S. Vienna, Va.

Print No. Ins. 121 on Reader Service Card

Miniature Temperature Indicating Label with 1% Accuracy

New temperature indicating label is only ¼″ square. The model 200 "Temp-Plate" is useful for instrumenting transistors and other miniature electronic components, inaccessible machinery areas, and general industrial or aviation equipment. The hermetically sealed plastic adhesive tab is said to stick on almost any surface and to turn black when its temperature reaches any desired value between 100°F and 500°F. It is



claimed to have an accuracy of ±1% and to be impervious to most shop and flight line or launching area atmospheres. Pyrodyne Inc., 11973 San Vicente Blvd., Los Angeles 49.

Print No. Ins. 122 on Reader Service Card

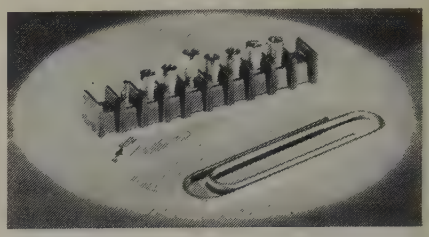
Liquid Resin for Masking Wire Leads, Other Parts

New liquid resin for masking or temporary protection of wire leads, lugs, contact points, and other parts or components during resin coating, spraying, potting, dipping, and other insulating processes contains no waxes and requires no heating or drying for use. Called "Isochemmask," it is a water solution of a vinyl resin that reportedly will not allow epoxy, polyester, silicone, or polyurethane coatings to penetrate. It can be removed by friction or by a solvent. Manufacturer claims it causes no electrical degradation of leads or other wires, is not corrosive and will not pit metals, has excellent mold release features, and can be used to patch and repair plastisol or metal molds and to seal them. Isochem Resins Co., 221 Oak St., Providence 9, R. I.

Print No. Ins. 123 on Reader Service Card

Subminiature Terminal Block For Fast Assembly

A new subminiature terminal block featuring faster and easier connections is especially adaptable to aircraft electronic and electrical use



where miniaturization is of prime importance and high vibration and shock conditions exist. Type 409-1802 utilizes a molded-barrier block which measures only 5/16″ in overall width, and can accommodate up to 21 terminals, plus mounting holes, in an overall length of only 4⅜″. It also offers extra-long leakage paths between terminals due to the barrier design. The body material is plastic, meeting MIL-M-14 specifications. Studs and nuts are brass, nickel plated, and may be gold plated on special order. Kulka Electric Corp., 633-643 S. Fulton Ave., Mt. Vernon, N. Y.

Print No. Ins. 124 on Reader Service Card

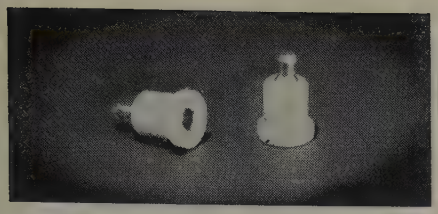
Instant-Drying Ink for Coloring Vinyl Insulated Wire

Instant-drying "Spectra-Ink" for the coloring of vinyl insulated wire is said to require no heat, no tower, and no special work area for application. Drying is so fast that production is not impeded. Any ordinary wind up machine will handle the job of pulling the wire through the ink tank. Spectra-Strip Wire & Cable Corp., P.O. Box 415, Garden Grove, Cal.

Print No. Ins. 125 on Reader Service Card

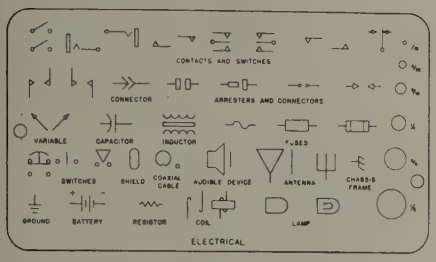
Space-Saver Test Jack

A new "Teflon"-insulated test jack is designed for assembles where space is at a premium. The new unit is designated Type SKT-37. SKT-37 receives a .090″ diameter probe, .140″ long. Overall diameter, above the chassis, is only .218″, while overall height, including mounting shoulder and soldering stud, is only .340″. The



new test jack has a .170″ diameter body for the through-chassis mounting. The body is made of a solid piece of machined, virgin Teflon. Sealectro Corp., 610 Fayette Ave., Mamaroneck, N. Y.

Print No. Ins. 126 on Reader Service Card



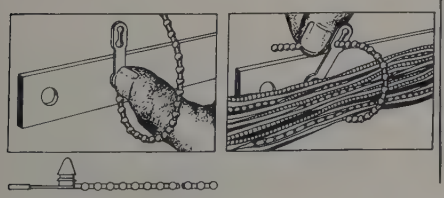
Template Symbols for Use in Electrical and Electronic Drawings

Two handy templates for electrical and electronic drawings are tradenamed "Speedraft." The electrical symbol template contains symbols for power, communications, and electronic wiring diagrams. The electronic symbol template simplifies the drawing of various types of electronic tubes and semi-conductors. All symbols on the templates conform to ASA and military specifications. Keuffel & Esser Co., Adams and Third Sts., Hoboken, N.J.

Print No. Ins. 127 on Reader Service Card

Polyethylene Wire Tie Clamps

A new combination wire tie and cable clamp is said to cut material costs and speed assembly by eliminating separate cable clamps, mounting screws, and wire ties in many applications. The push-button mounting snaps into any .250-.265″ diameter hole, securely fastening the tie to the chassis or frame. The "E-Z" wire tie adjusts to 30 different sizes from ⅛″ to 1-5/16″ diameter and can be opened and closed to add or repair wires without removing the push but-



ton mounting. These tie-clamps, made from high dielectric polyethylene, are stated to be chemically inert and heat resistant. They are available in three different colors, 5½″ long. Free samples and literature available. Richco Plastic Co., 3722 West North Ave., Chicago 47.

Print No. Ins. 128 on Reader Service Card

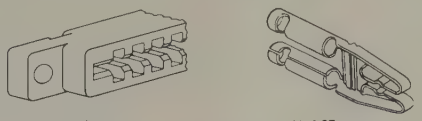
Thermoplastic Sheathed Cable

A new cable, constructed of thermoplastic inner conductors and thermoplastic jacket, is designed to simplify and speed modern wiring through easier pulling and stripping and greater flexibility than previous types of non-metallic sheathed cable. Additional advantages claimed are superior impact strength, improved appearance, and resistance to flame and moisture. Approved by Underwriters' Laboratories, Inc. American Insulated Wire Corp., 36 Freeman St., Pawtucket, R.I.

Print No. Ins. 129 on Reader Service Card

22-Contact Printed Circuit Connector

A one-piece edge connector which accommodates easy-to-insert, easy-to-remove taper pins is designed for printed circuit card applications in which frequent jumpering is necessary, or in which numerous circuitry changes must be made. The connector, called the AMP Taper-in, will mount all .070-.005 printed circuit cards. It has 22 contact positions, with contacts commoned for multiple-wire use. The block is ester alkyd, glass-filled.



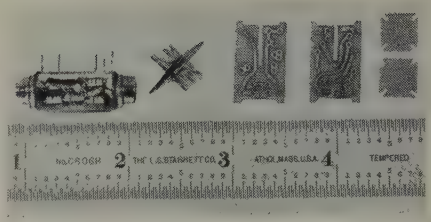
HOUSING CONTACT

The taper pin receptacles are lettered and numbered, with the letters and numbers recessed. AMP Inc., Harrisburg, Pa.

Print No. Ins. 130 on Reader Service Card

Tiny Printed Circuit Modules

A printed circuit modular construction known as the "PLUS" module consists of crossed printed circuit boards interlocking to form a structural column. End plates may also be printed circuits and can carry tube sockets or transistors and plug-in connectors. The structure can be made

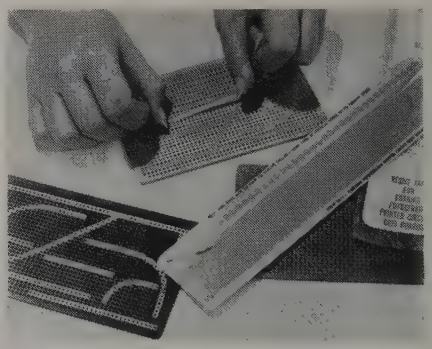


in a wide variety of shapes and sizes including a sub-miniature version about ⅜″ square. The new structure is said to offer advantages in miniaturization by providing the maximum circuit board area in a given space, as well as a rugged, self supporting structure for high shock and vibration. Arthur Ansley Mfg. Co., New Hope, Pa.

Print No. Ins. 131 on Reader Service Card

Plastic Strips and Dots for Making Printed Circuits

Acid-resistant plastic strips and dots are now available in kits for laying out prototype circuits on copper-clad "Fotoceram" grid boards. When the boards are dipped in acid all copper is etched away except in areas lying under the plastic, leaving a printed circuit on a glass-ceramic substrate. The plastic reportedly adheres on contact, yet lifts easily after etching or if corrections are desired before etching. Kits contain ten 9″ x



⅛″ strips and forty 3/16″ dots. Price is 75 cents. Corning Electronic Components, Corning Glass Works, Bradford, Pa.

Print No. Ins. 132 on Reader Service Card

U/L Approved FEP Wire

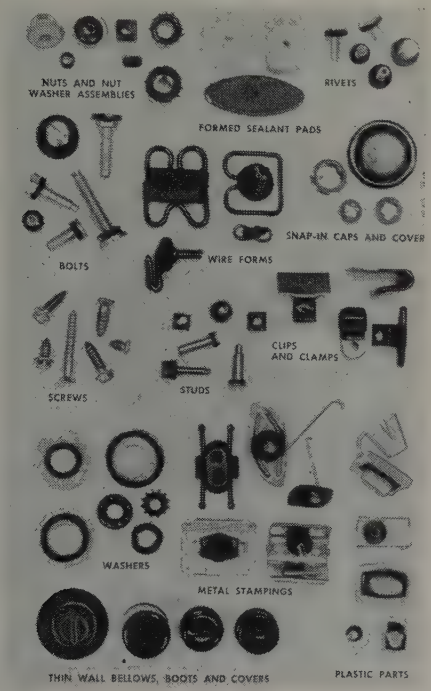
New U/L approval covers 10-mil walls of "Teflon" FEP insulated wire for 80°C and 105°C operation in sizes #20 AWG thru #26 inclusive, solid or stranded, tinned, nickel coated, or silver coated copper. The labeling of this material is for the restrictive use of office appliances where wire exposure will not exceed

80°C, or when exposed to oil temperature will not exceed 60°C, and where not subjected to undue mechanical abuse. William Brand-Rex Div., American Enka Corp., 31 Sudbury Road, Concord, Mass.

Print No. Ins. 133 on Reader Service Card

Pre-Applied Sealants

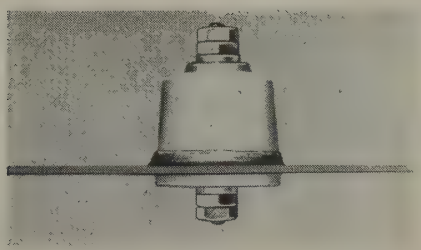
Selective placement and positive adherence of a sealant in any elastomeric material is claimed to be possible in any shape, form, size, or dimension on any productive part. Sealants reportedly can be applied by a newly developed mass production method which eliminates after-assembly sealing and provides a much superior seal. Problems caused by water, moisture, dirt, dust, fumes, gases, and chemicals, or those caused by sound, vibration, odor, corrosion, and deterioration are said to be controlled and simplified while eliminating the assembly line sealing process and effecting savings in costs and time, plus assuring a greatly improved permanent seal. Automotive Rubber Co., 12550 Beech Rd., Detroit 39.



Print No. Ins. 134 on Reader Service Card

Hermetically Sealed High Voltage "Teflon" Feed-Thru Insulator

A silver-based Teflon feed-thru insulator is especially designed for permanent applications and incorporates a hermetic solder seal. The Chemelec Multi-Bond insulator provides a fluorocarbon-silver metal fused seal

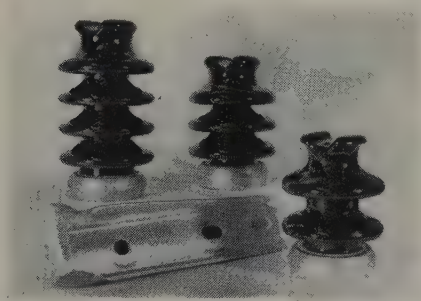


permitting the insulator to be soldered directly to the deck. Garlock Electronic Products, Garlock Inc., Camden 1, N.J.

Print No. Ins. 135 on Reader Service Card

15 KV Distribution Post

A new distribution post insulator is rated at 15 kv. The new 15-kv unit, catalog No. 4315A, is a solid, vacuum process porcelain post cemented into a galvanized steel base and mounted with standard line post studs. Completely puncture proof (solid porcelain) and free from radio and television interference without coating, treatment, or attachment, the new

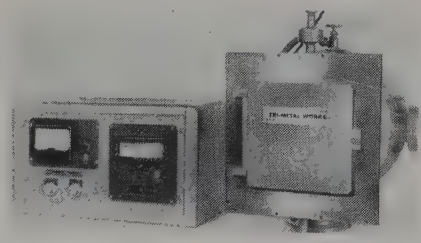


post is also claimed to be strong mechanically (1500 lbs) and rugged against power arc-over and mechanical abuse such as stones and bullets. Fog-type petticoats are said to provide best operation under contamination conditions. Lapp Insulator Co. Inc., Le Roy, N. Y.

Print No. Ins. 136 on Reader Service Card

High Vacuum Ovens for 0-800°C Use

New "cold wall" (water cooled shell) high vacuum bake ovens are said to be capable of operating continuously at any temperatures from 0-500°C and 0-800°C. Temperature uniformity within the work zone reportedly is held to within ±3°C. Construction incorporates a suspended

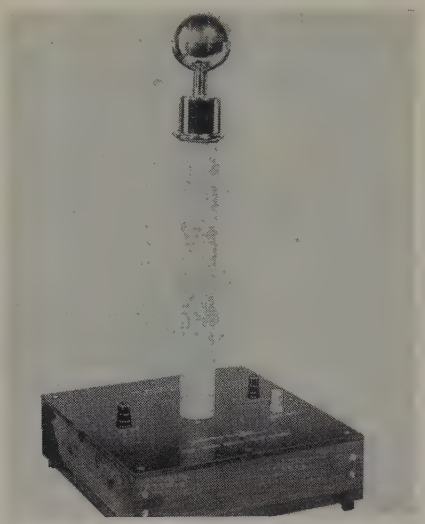


muffle heated by radiant heaters and reflective shielding to achieve better temperature uniformity and control and faster heat-up and cool-down. The ovens are offered with or without one of several different vacuum pumping systems. Tri Metal Works Inc., 1600 Bannard St., Riverton, N. J.

Print No. Ins. 137 on Reader Service Card

Corona Pick-Up Network

A corona pick-up network to extract the corona signal from a high potential circuit, model 8562M1, consists of corona-free high voltage capacitor-divider circuit, associated filters, and circuitry. The high-voltage connection is located at the top of an insulating cylinder approximately 18″ in height. This cylinder is mounted on



a base which contains the terminals for connection to an oscilloscope or to other corona detection devices. Models are available for use with potentials to 100 kv. Associated Research Inc., 3777 West Belmont Ave., Chicago 18.

Print No. Ins. 138 on Reader Service Card

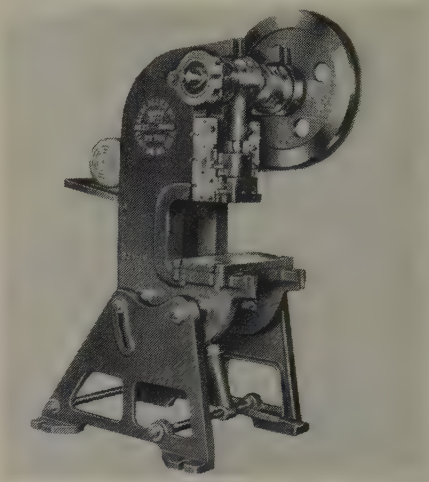
Continuity Tester And Flashlight

"Flash-Test," a new combination continuity-tester and flashlight said to be shockproof can be used to test all types of fuses and appliances, in addition to providing regular spotlight coverage. It is designed without confusing test wires or switches and locates short circuits, wire breaks, or blown fuses. Selcin Corp., Box 88, Medford 55, Mass.

Print No. Ins. 139 on Reader Service Card

Heavy Duty 25-Ton Punch Press

The model BT-25 25-ton press has a die space of 7-3/8″ shut height and an 8″ throat. The new BT-25 can be easily set up for any standard punch press operation, such as blanking, forming, shearing, riveting, drawing, cutting, punching, crimping, etc. It is equipped with a single pin, knife type



clutch and can be easily changed from repeat (continuous) to non-repeat (single stroke) action. Die bed is 12″ x 21″ with opening in bed 5″ x 8″. Mechanical tilting mechanism allows press to incline to 30°. Alva Allen Industries, 1001-15 N. 3rd St., Clinton. Mo.

Print No. Ins. 140 on Reader Service Card

New Infrared Heat Source with Accurate Temperature Control

A completely controllable, flameless, catalytic method of producing low-temperature infrared heat is suitable for a wide variety of heat transfer requirements, including baking, drying, curing, bonding, preheating, softening, and evaporating. LP gas energy is directly converted to infrared heat energy on a catalytically active metal screen—the screen itself is the radiant heat source. Surface temperature of the catalyst screen reportedly can be held automatically at any point be-

tween 800°F and 1500°F by proportionate control of the gas flow. The low temperature range permits work to be placed very close to the infrared heat source to obtain optimum heat transfer efficiency. Heating times are shorter, production can be increased, and size and cost of necessary enclosures can be reduced to a minimum, it is stated. Heating panels are available in standard sizes and are readily adaptable for mounting and grouping. Panels are designed to provide heat release rates between 2,000 and 12,000 BTU/hr/sq ft of emission surface. This is approximately equivalent to a range of 4 to 24 watts/sq in. Catalytic Combustion Corp., 4725 Fourteenth St., Detroit 8, Mich.

Print No. Ins. 141 on Reader Service Card

Unit Provides Inductance and Capacity Measurements at 1 MC

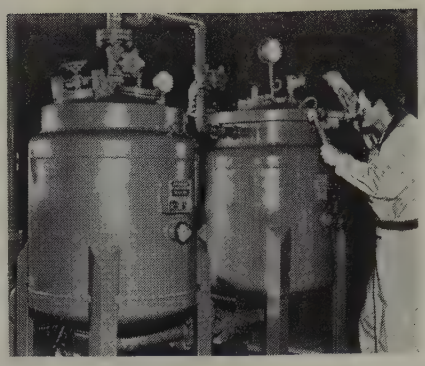
A new precision capacity measuring instrument is said to feature high accuracy, simplicity of operations, and a 1 mc measuring frequency. Model 402D "Micro-Miker" measures capac-

ity from 0 to 1000 $\mu\mu$f in three ranges and inductance from 0 to 140 μh in one range. Accuracy claimed is $\pm 2\%$ of the reading (typically $\pm \frac{1}{2}\%$) for capacity and $\pm 3\%$ for inductance. A stable zero and single 6″ engraved dial are the only controls necessary for capacity and inductance measurements. Price is $785 f.o.b. San Diego, Cal. C. E. S. Electronic Products Inc., 5026 Newport Ave., San Diego 7, Cal.

Print No. Ins. 142 on Reader Service Card

Insulation Vacuum Impregnation System With Quick-Opening Cover

Chief feature of a new vacuum impregnation system for insulation use is the quick-opening and quick-closing



cover on the impregnating chamber (right in photo). The cover is sealed shut by means of a new split-ring type of closure that has only one locking point, at the front of the unit, and reportedly can be clamped shut or wrenched open manually in less than one minute. Cover meets ASME code specifications and is spring-balanced for additional ease of opening. The chamber (24″ ID and 36″ inside clear height) is jacketed and designed to withstand 100 psig. steam pressure. The matching impregnant-storage reservoir (left in the photo) is also jacketed, so that cooling water can be circulated to keep the temperature of the resin below 70°F. The system, including all interconnecting piping, valves, and electrical wiring, is built together on a common base-plate 7 ft by 5 ft, ready to go to work immediately upon delivery. F. J. Stokes Corp., 5500 Tabor Rd., Philadelphia 20, Pa.

Print No. Ins. 143 on Reader Service Card

Miniaturized Phase Sequence Indicator

An instrument for indicating phase sequence in three-phase power systems has been miniaturized and now weighs but 11 oz, 37% smaller than predecessors. The new instruments are 2-7/8″ wide by 1-5/8″ deep and 4″

high. Model 40A is designed for 60-cycle power circuits and has a switch for adjustment to 120, 240, and 480 volts. Model 44A is for use on 400-cycle circuits. Associated Research Inc., 3777 W. Belmont Ave., Chicago 18.

Print No. Ins. 144 on Reader Service Card

Radiant Ovens with Heaters On All Sides of the Chamber

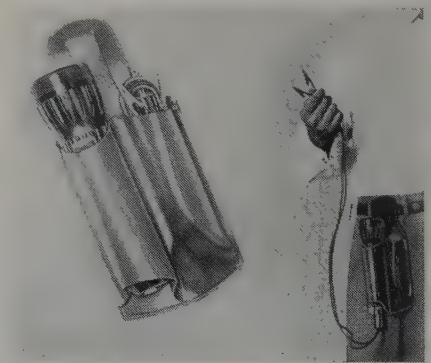
"Sola-Jet" radiant ovens are claimed to be a new concept in absolute constant-controlled temperature. Heaters are placed on all six sides of the chamber. Specially designed

"jack-in" heated aluminum shelves for applying direct heat to the work load are optional. Dept. 2, Temperature Engineering Corp., Riverton, N. J.

Print No. Ins. 145 on Reader Service Card

Combination Continuity Tester And Spotlight

Kit No. 313 consists of a multipurpose continuity tester and spotlight in convenient carrying case. It can be used to check wiring, controls, circuits, fuses, grounds, shorts, opens, broken wire, relays, switches, limits, burglar alarm systems, and for many

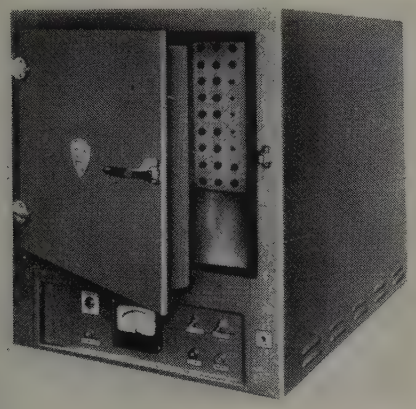


other purposes. The carrying case fits onto belt so that both hands are free for on-the-job convenience. Case is also available separately to carry tools, flashlight, and extra batteries. Price is $7.30. Bright Star Industries, Clifton, N. J.

Print No. Ins. 146 on Reader Service Card

Exact Temperature Chamber

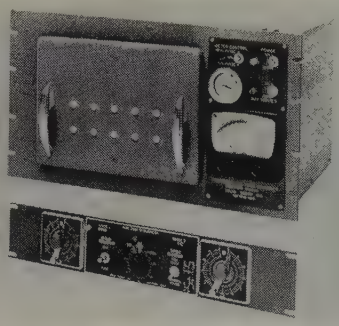
Exact temperature throughout all areas is said to be provided by a new diffused "Aer-Heet" chamber. Horizontal convection is employed to attain exact temperatures to a maximum 550°F (288°C) across the entire area of each shelf. Finest temperature gradients are also featured. Dept. 1, Temperature Engineering Corp., Riverton, N. J.



Print No. Ins. 147 on Reader Service Card

Automatic Timer for Temperature Cycling

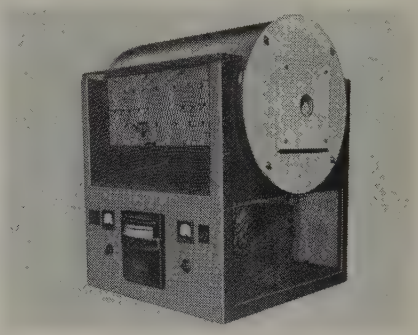
Automatic cycling between high and low temperatures with temperature chamber is said to be achieved by the new MR-1 timer. Stated range is −100 to +500°F (−73.3 to +260°C), and accuracy is ±½°F. Used with the MR-1, the fast response model 1060RF chamber reportedly can complete a cycle in 12 min. The model MR-1 timer is packaged for rack or bench mounting and measures only 19″ × 3½″ × 3½″. Delta Design Inc., 7460 Girard Ave., La Jolla, Cal.



Print No. Ins. 148 on Reader Service Card

2600°F Electric Combustion Tube Furnace

An electric combustion tube furnace incorporating a new type of power control is stated to produce 2600°F (1427°C) maximum. Model SC-32 provides a 12″ uniform heat zone in a 2½″ OD ceramic tube, and is rated at 7 kw on 220/1/60 vac. The new power control, called "Thermionik" power system, uses thyratron electronic tubes. The thyratrons are said to allow greater accuracy of temperature control. Model SC-32 is available with automatic indicating-type controls and mounts for customer-specified two to four-inch OD tubes. It is also available as muffle-type. Despatch Oven Co., 619 S. E. 8th St., Minneapolis 14, Minn.



Print No. Ins. 149 on Reader Service Card

New Literature

All catalogs, bulletins, and other literature or sample cards described are available free of charge. To obtain your free copies, just print the item number on the Reader Service Card on the back cover. Fill out and mail the card—no postage is required. Insulation *immediately forwards your requests to the companies concerned so that the literature can be sent to you promptly.*

Standard Specification Sheet For Nylon Threaded Fasteners

New standard specification sheet for nylon molded threaded insulating fasteners covers the six head types available for nylon machine screws: round, binding, oval, washer, flat, and fillister; and the six point types available for nylon headless set screws: plain, oval, cone, flat, half dog, and full dog. It also gives complete details on threads and principal dimensions for all head types. 1 page. Gries Reproducer Corp., 400 Beechwood Ave., New Rochelle, N.Y.

Print No. Ins. 201 on Reader Service Card

Booklet on ABS Resins and Compounds

New service bulletin G-22 covers a line of rigid acrylonitrile-butadiene-styrene resins and compounds for use in the electrical, automotive, appliance, business machine, and other industries. The materials are described, suggested applications are listed, tables of electrical and other properties are given, and the various methods of processing and fabrication are discussed. 12 pages. B. F. Goodrich Chemical Co., a division of The B. F. Goodrich Co., 3135 Euclid Av., Cleveland 15.

Print No. Ins. 202 on Reader Service Card

Catalog of Laminated Plastic Sheets, Rods, and Tubing

New illustrated catalog describes laminated plastic sheets, rods, and tubing for use in the electrical and electronics fields, and in the refrigeration, automotive, aircraft, missile, and other industries. Technical data given include NEMA grades, colors, finishes, size and thickness ranges, strength, density, water absorption, impact strength, power factor, insulation and arc resistance, dielectric properties, and special features. A wide variety of laminated sheets are listed, including paper, canvas, linen, asbestos fabric, glass, nylon fabric base, and copper-clad laminates for printed circuits. The section on tubing and rods includes data for parts made on all bases and with silicone, melamine, epoxy, and phenolic resin binders. Catalog offers information on standard applications for laminates and suggests a "world of new applications." 18 pages. Dept. WMG, Panelyte Div., St. Regis Paper Co., Trenton 8, N.J.

Print No. Ins. 203 on Reader Service Card

Electrical Tape Property Chart

"Reference Data for Design Engineers," is the title of an easy-to-read property chart covering all "Scotch" brand pressure-sensitive electrical tapes. Designed for quick reference by designers, the chart lists typical properties, standard slitting tolerances, standard lengths, and military specifications of 31 tapes, ranging from paper to silicone rubber. 4 pages. Minnesota Mining and Manufacturing Co., Dept. WO-482, 900 Bush Ave., St. Paul 6, Minn.

Print No. Ins. 204 on Reader Service Card

High Temperature Insulation Folder

New folder covers "Teflon" extruded tubing, silicone rubber extruded tubing, silicone rubber tape, silicone rubber coated braided glass sleeving, Teflon insulated wire and cable, and silicone rubber insulated wire and cable. Each product is described and illustrated, properties are listed, and applicable military specifications are given. 4 pages. L. Frank Markel & Sons, Norristown, Pa.

Print No. Ins. 205 on Reader Service Card

Bulletin on Epoxy Insulations

New bulletin on epoxy insulation coatings lists desirable characteristics, outstanding features, and problems they solve. The bulletin also illustrates other specialized services such as bonding of stator and rotor laminations; component impregnation and encapsulation; mold making; and wire winding. 2 pages. Spatco Manufacturing Co. Inc., 45-31 Davis St., Long Island City 1, N.Y.

Print No. Ins. 206 on Reader Service Card

Glass-Bonded Mica Applications Folder

New folder outlines advantages of 'Mykroy" glass-bonded mica in insulator applications. It features engineering sketches and data on a variety of applications calling for the combination of mechanical and electrical characteristics which make the glass-bonded mica a desirable material for high frequency, high temperature applications. Special emphasis is given characteristics such as dimensional stability, low loss factor, zero moisture absorption, thermal expansion which matches insert metals, dielectric strength, arc resistance, machinability, and moldability. Electronic Mechanics Inc., 101 Clifton Blvd., Clifton, N.J.

Print No. Ins. 207 on Reader Service Card

Data Sheet on Polyethylene Resins

New data sheet PRTD-1 lists the most commonly-used "Petrothene" polyethylene resins, their main characteristics, and their predominant applications. Several of the many available compounded resins are also listed. This data sheet is meant to serve as a general guide, and does not list all polyethylene resins or all possible applications. 4 pages. U.S. Industrial Chemicals Co., Division of National Distillers and Chemical Corp., 99 Park Ave., New York 16.

Print No. Ins. 208 on Reader Service Card

Catalog of Polycarbonate and Phenolic Resins, Varnishes, and Molding Powders

A complete line of polycarbonate resins, phenolic resins, varnishes and molding powders, and fused magnesium oxide is described in catalog CDC-381. The illustrated catalog covers product features, applications, and detailed technical data. 12 pages. Chemical Materials Dept., General

Electric Co., One Plastics Ave., Pittsfield, Mass.

Print No. Ins. 209 on Reader Service Card

Bulletin on Ceramic Metalizing

A new engineering bulletin on the metalizing of ceramic parts describes how permanent bonding techniques have increased the versatility of ceramic materials—extending their applications into fields where expensive metal alloys were formerly required. It discusses the preliminary design and engineering considerations involved, and also covers the properties and applications of steatite and high alumina ceramics suitable for low and high temperature metal-to-ceramic seals. 1 page. Centralab, The Electronics Division of Globe-Union Inc., 900 East Keefe Ave., Milwaukee 1.

Print No. Ins. 210 on Reader Service Card

Bulletin on Machining Reinforced 'Teflon'

Recommended methods of machining reinforced Teflon materials are described in a new technical bulletin. It covers handling, tools and work setup, heavy machining, drilling and reaming, tapping, finish grinding, and miscellaneous considerations. 2 pages. Rogers Corp., Rogers, Conn.

Print No. Ins. 211 on Reader Service Card

Coated Glass Fabric Brochure

New brochure describes coated glass fabrics for electrical applications. A variety of applications are shown, including hand wound and stick wound transformer coil insulation, heavy duty transformer coil insulation, and motor end turn coil insulation. Products described include epoxy and varnish coated glass. Surface finishes available and typical properties including tensile strength, electric strength, specifications, and thicknesses are listed. 6 pages. Dept. WO-507, Irvington Div., Minnesota Mining and Manufacturing Co., 900 Bush Ave., St. Paul 6, Minn.

Print No. Ins. 212 on Reader Service Card

Folder on Connectors and Accessories For Printed Circuit Boards

New folder describes a complete line of one-piece and two-piece multiple connectors for printed circuit boards. Detailed lists of the features are given. Precise line drawings of each of five types of snap-in contacts are shown, with descriptions of the unique design features of each type. Cut-away drawings of the variety of connector housings available are also illustrated. Other products for printed circuitry, including component tips, single circuit edge connectors, and printed circuit pins, are described and illustrated. One full page is devoted to a description of a solderless termination technique—the compression-crimp technique—for applying the contact directly to the wire end. 6 pages. AMP Inc., Harrisburg, Pa.

Print No. Ins. 213 on Reader Service Card

Bulletin on Continuous Mining Machine Cable

New Bulletin DM-5944 supplies data on a flexible, easily handled neoprene insulated training cable which was job-designed for continuous coal-mining machines. Data on three available configurations are tabulated. 4 pages. Dept. EFL, Anaconda Wire & Cable Co., 25 Broadway, New York 4.

Print No. Ins. 214 on Reader Service Card

Wire and Cable Stock Lists

Stock list of insulated magnet wire, cord, and cable shows types available. 2 pages. Service & Wire Inc., 2051 Pontius Ave., Los Angeles 25.

Print No. Ins. 215 on Reader Service Card

Wire for Semiconductor Use

Brochure outlines important factors involved in maintaining the physical and electrical properties of the many metals and alloys used by the semiconductor industry "so that a high degree of reproducibility can be achieved." Discussed at length are the various purities and properties of gold and doped gold alloys as well as aluminum and doped aluminum wire. Tin, indium, and lead coated wire for semiconductor applications are likewise discussed in detail. Electroplating on wire and ribbon rolling data are also covered. 4 pages. Secon Metals Corp., 7 Intervale St., White Plains, N.Y.

Print No. Ins. 216 on Reader Service Card

Literature on Insulation Formers and Machines for Insulating Slots

Machines for inserting insulations

into stators and armatures as well as equipment for inserting slot wedges and machines for cutting and forming insulation are described and illustrated in bulletins. Data sheets give specifications. 18 pages. The Globe Tool & Engineering Co., 5051 Kitridge Rd., Dayton 24, Ohio.
Print No. Ins. 217 on Reader Service Card

Catalog of Vacuum Ovens, Heating Chambers, Baking Systems, Etc.

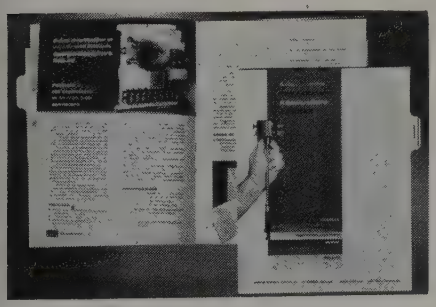
Illustrated product catalog describes vacuum ovens, diffused heating chambers, radiant ovens, "dri-box" vacuum bake systems, modular controlled atmosphere enclosures, and vacuum equipment. It contains illustrations, descriptive drawings, and technical specifications. 30 pages. Temperature Engineering Corp., Box NL 1, Riverton, N.J.
Print No. Ins. 218 on Reader Service Card

Potting, Impregnating, Molding, Drying, And Foaming Equipment Catalog

New brochure #E-1160 for the electrical and electronics industries covers modern production systems used by these industries for impregnating, potting, encapsulating, plastics molding, relay drying and filling systems, urethane foaming, vacuum drying, upgrading of oils and waxes, and vacuum melting and heat treating. 4 pages. Hull Corp., Hatboro, Pa.
Print No. Ins. 219 on Reader Service Card

Catalog of Temperature Regulators

Temperature regulating devices said to be capable of routinely controlling air or liquid temperatures within a fraction of a degree are



covered in new illustrated catalog 360. Many typical applications are outlined. Bimetal and mercury thermoregulators, heaters, relays, stirrers, pumps, and transformers are included. American Instrument Co. Inc., 8030 Georgia Ave., Silver Spring, Md.
Print No. Ins. 220 on Reader Service Card

Dates to Circle

Meeting and Convention Notices

Jan. 29-Feb. 3 . . . AIEE, Winter General Meeting, Hotel Statler, New York City.

Jan. 30-Feb. 3 . . . ASTM, Committee Week, Netherland-Hilton Hotel, Cincinnati.

Feb. 1-3 . . . 2nd Winter Military Electronics Convention, sponsored by the National Professional Group on Military Electronics and the Los Angeles Section of IRE, Biltmore Hotel, Los Angeles.

Feb. 5-11 . . . National Electrical Week.

Feb. 7-9 . . . SPI, 16th Reinforced Plastics Division Conference, Edgewater Beach Hotel, Chicago.

Feb. 13-16 . . . Semi-Annual Meeting and 15th International Heating and Air Conditioning Exposition, American Society of Heating, Refrigerating and Air-Conditioning Engineers, Conrad Hilton Hotel and International Amphitheatre, Chicago.

Feb. 15-17 . . . AIEE, IRE, and the University of Pennsylvania, International Solid-State Circuits Conference, University of Pennsylvania and the Sheraton Hotel, Philadelphia, Pa.

Feb. 20-25 . . . International Symposium on Semiconductor Devices, UNESCO, 2 Place Fontenay, Paris, France.

Feb. 26-Mar. 1 . . . First Annual Pacific Electronic Trade Show, Great Western Exhibit Center, Los Angeles.

Mar. 9-10 . . . Symposium on Engineering Aspects of Magnetohydrodynamics, AIEE, IAS, IRE, and Univ. of Pa., University Park, Philadelphia, Pa.

Mar. 15-17 . . . EIA, Spring Conference, Washington, D.C.

Mar. 20-23 . . . IRE, National Convention, Coliseum and Waldorf-Astoria Hotel, New York City.

Mar. 21-25 . . . Electrical Engineers Exhibition, Earls Court, London. For information, contact Electrical Engineers Exhibition Ltd., 6 Museum House, 25 Museum St., London, W.C.I.

Apr. 5-7 . . . AIEE, South East District Meeting, Jung Hotel, New Orleans, La.

Apr. 5-7 . . . ASTM, Symposium on Materials and Electron Device Processing, Benjamin Franklin Hotel, Philadelphia.

Apr. 10-11 . . . Rubber and Plastics Industries Conference, Sheraton Hotel, Akron, Ohio.

Apr. 17-21 . . . American Welding Society, Annual Convention and Welding Exposition, Commodore Hotel and New York Coliseum, New York City.

Apr. 19-21 . . . AIEE, Great Lakes District Meeting, Hotel Pick-Nicolett, Minneapolis, Minn.

Apr. 19-21 . . . Annual Southwestern Institute of Radio Engineers Conference & Electronics Show, Dallas Memorial Auditorium and The Baker Hotel, Dallas, Texas.

Apr. 20-21 . . . SPI, 18th Annual Western Section Conference, Hotel del Coronado, Coronado, Cal.

Apr. 26-28 . . . IRE, 7th Region Technical Conference & Trade Show, Westward Ho Hotel, Phoenix, Ariz.

Apr. 30-May 4 . . . Electrochemical Society, Spring Meeting, Claypool Hotel, Indianapolis, Ind.

May 1-2 . . . AIEE, Rural Electrification Conference, Kentucky Hotel, Louisville, Ky.

May 2-4 . . . Electronic Components Conference, AIEE, IRE, EIA, and WEMA, Jack Tar Hotel, San Francisco.

May 7-8 . . . IRE, 5th Midwest Symposium on Circuit Theory, University of Illinois, Urbana, Ill.

May 8-9 . . . SPI, Nineteenth Canadian Section Conference, Sheraton-Brock Hotel, Niagara Falls, Ont., Canada.

May 8-10 . . . IRE, NAECON, Miami and Biltmore Hotels, Dayton, Ohio.

May 9-11 . . . Western Joint Computer Conference, sponsored by AIEE, IRE, and Assoc. of Computer Manufacturers, Ambassador Hotel, Los Angeles.

May 17-19 . . . AIEE, North Eastern District Meeting, Statler Hotel, Hartford, Conn.

May 23 . . . AIEE, Fractional Horsepower Motors Conference, Biltmore Hotel, Dayton, Ohio.

May 24-26 . . . EIA, 37th Annual Convention, Chicago.

June 5-9 . . . SPI, Annual National Plastics Conference and Exposition, Commodore Hotel and the Coliseum, New York City.

June 11-14 . . . NISA, Annual Convention, Jack Tar Hotel, San Francisco, Cal.

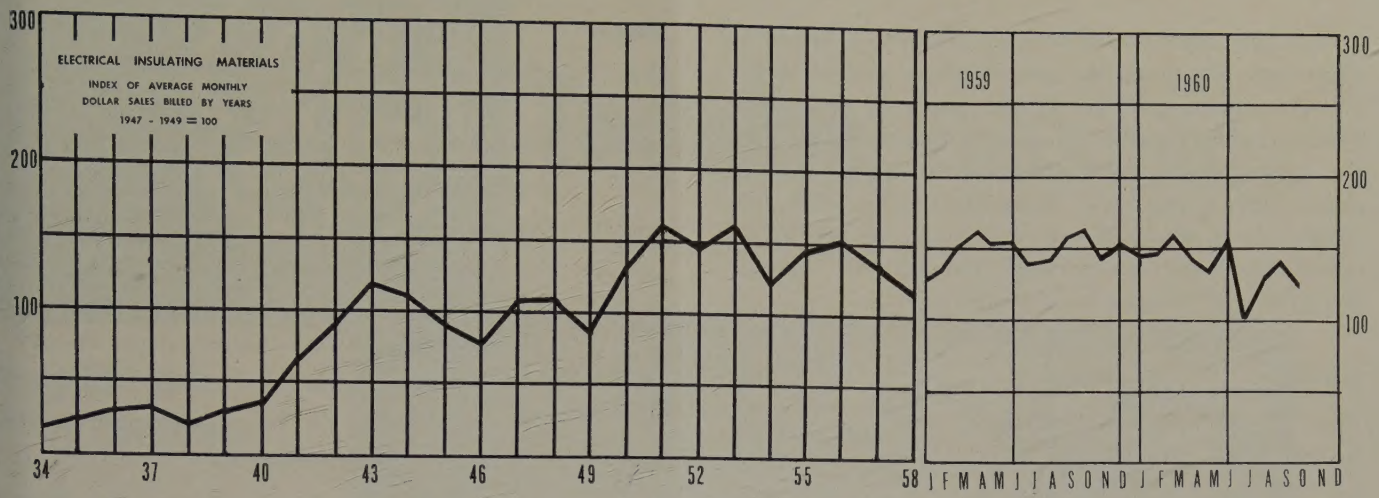
June 18-23 . . . AIEE, Summer General Meeting, Cornell University, Ithaca, N. Y.

June 25-30 . . . ASTM, 64th Annual Meeting, Chalfonte-Haddon Hall, Atlantic City, N. J.

Abbreviations Used in Notices

AIEE	—American Institute of Electrical Engineers
ASTM	—American Society for Testing Materials
ASME	—American Society of Mechanical Engineers
ASA	—American Standards Assn.
IRE	—Institute of Radio Engineers
EIA	—Electronic Industries Assn.
NEMA	—National Electrical Manufacturers Assn.
NISA	—National Industrial Service Assn.
SPE	—Society of Plastics Engineers
SPI	—Society of the Plastics Industry
WEMA	—Western Electronic Manufacturers Assn.

NEMA Electrical Insulation Index



	Oct. '60	Sept. '60	Oct. '59
Index Series	124	142	164
Oct. '60 point change from other mos.		—18	—40
Oct. '60 % change from other months		—13	—24

Index is based on 1947-1949 average month, inclusive= 100

Published through the courtesy of the National Electrical Manufacturers Association

Materials Used in Electrical Insulation Index

Industrial Laminated Products
Manufactured Electrical Mica
Varnished Fabric and Paper
Vulcanized Fibre
Coated Electrical Sleeving

Advertisers' Index

To obtain more information on products of Insulation *advertisers, just print the advertisement number shown for each advertiser in one of the spaces on the Reader Service Inquiry Card on the inside back cover. This number appears under each advertisement and is also repeated in the listing below. After filling out the card completely, tear it off and drop it in the mail—no postage required.* Insulation *will promptly forward your requests for further information to the advertisers.*

Number	Advertiser	Page
Ins. 32	American Electrical Heater Co.	58
Ins. 24	Anaconda Wire & Cable Co.	49
Ins. 37	Artos Engineering Co.	62
Ins. 43	Associated Research, Inc.	71
Ins. 10	Atlas Asbestos Co.	14
Ins. 55	Belding Corticelli	79
Ins. 58	Bentley-Harris Manufacturing Co.	Outside Back Cover
Ins. 11	George C. Borthig Co., Inc.	15
Ins. 23	Chemical & Power Products, Inc.	48
Ins. 44	Chemplast, Inc.	71
Ins. 34	Coast Mfg. and Supply Co.	59
Ins. 33	The Connecticut Hard Rubber Co.	58
	Continental-Diamond Fibre Corp.	24
Ins. 22	J. P. Devine Mfg. Co.	47
Ins. 7	Dow Corning Corp.	10 & 11
Ins. 51	The Electrical Refractories Co.	76
Ins. 30	Food Machinery and Chemical Corp., Dapon Dept.	55
	General Electric Co.	
Ins. 13	Insulating Materials Dept.	23
Ins. 57	Laminated Products Dept.	Inside Back Cover
Ins. 35	Silicone Products Dept.	61
Ins. 36	J. J. Glenn and Co.	62
Ins. 56	Grieve-Hendry Co., Inc.	79
Ins. 21	Hess, Goldsmith & Co., Inc., Horace Linton Div.	46
Ins. 46	Hinchman Manufacturing Co.	73
	Hudson Wire Co.	
Ins. 38	Ossining Div.	63
Ins. 25	Winsted Div.	50
Ins. 49	Ideal Industries, Inc.	75
Ins. 27	Industrial Instruments, Inc.	52
Ins. 9	The Iten Fibre Co.	13
Ins. 3	The Macallen Co.	2
Ins. 18	L. Frank Markel & Sons	41
Ins. 2	Minnesota Mining & Manufacturing Co., Mica Insulator Div.	1
Ins. 41	Mitchell Rand Manufacturing Co.	68
	Molded Fiber Glass Co.	56
Ins. 19	Mosinee Paper Mills Co.	43
Ins. 52	Mystik Adhesive Products, Inc.	77
Ins. 14	Narmco Materials, A Subsidiary of Telecomputing Corp.	29
Ins. 8	Natvar Corp.	12
Ins. 29	New England Mica Co., Inc.	54
Ins. 6	New Jersey Wood Finishing Co.	9
Ins. 12	Norton Co.	16
Ins. 1	Permacel	Inside Front Cover
Ins. 50	Peschel Electronics, Inc.	76
Ins. 31	Phelps Dodge Copper Products Corp.	57
Ins. 48	Pyles Industries, Inc.	75
Ins. 40	Raybestos-Manhattan, Inc., Asbestos-Textile Div.	67
Ins. 4	Rayclad Tubes Inc., A Subsidiary of Raychem Corp.	5
Ins. 15	Reichhold Chemicals, Inc.	30
Ins. 47	Riegel Paper Corp.	75
Ins. 16	Rubber & Asbestos Corp.	37
Ins. 53	Sauereisen Cements Co.	78
Ins. 28	Shawinigan Resins Corp.	53
Ins. 17	Spaulding Fibre Co., Inc.	38
Ins. 42	Sprague Electric Co.	69
Ins. 54	Herman H. Sticht Co., Inc.	78
Ins. 39	Taylor Fibre Co.	65
Ins. 20	Union Carbide Corp., Union Carbide Plastics Co. Div.	45
Ins. 26	Varflex Sales Co., Inc.	51
Ins. 5	Westinghouse Electric Corp., Micarta Div.	6 & 7
Ins. 45	Young Brothers Co.	73

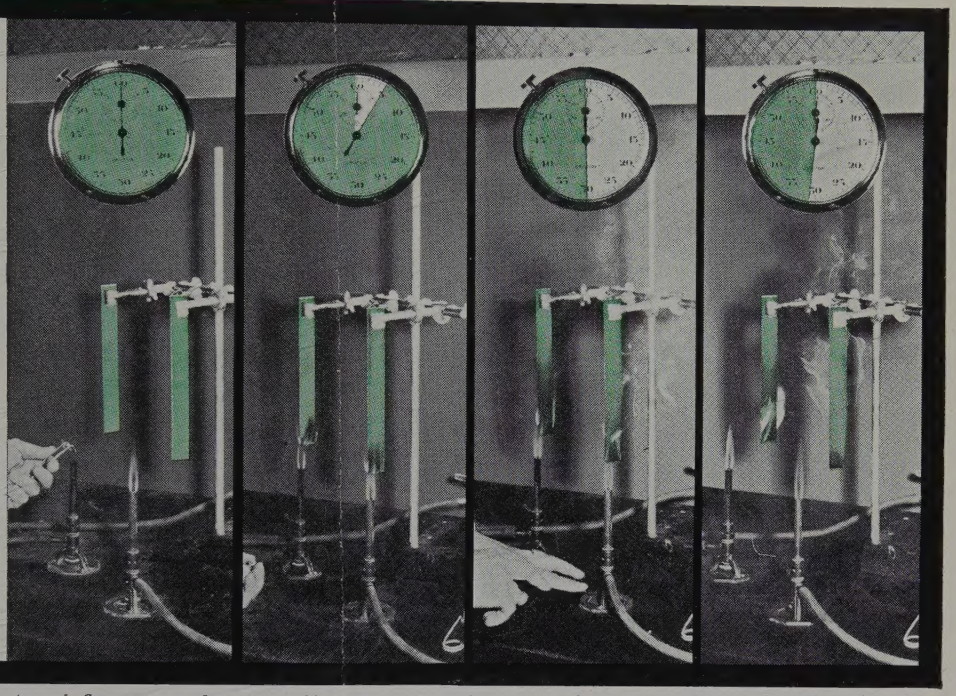
Advertising Sales Offices:
Libertyville, Ill.—(General Offices) P.O. Box 270, 311 E. Park Ave. Phone EMpire 2-8711
Chicago 11, Ill.—John MacKay and Philip Holmes
410 N. Michigan Ave. Phone WHitehall 4-2883
Detroit 26, Mich.—Charles R. Schroeder
413 Lafayette Bldg. Phone WOodward 1-0278
New York 17, N.Y.—Robert Bandini and Roland Robitaille
41 E. 42nd St. Phone MUrray Hill 2-3157
Pacific Coast—H. L. Mitchell & Assoc., 1450 Lorain Road. San Marino, Calif. Phone CUmberland 3-4394
(Central California only—James T. Stevenson, 5901 Buena Vista Ave., Oakland 18, Calif. Phone OLympic 3-8602)

Textolite® / reliability

computer and
ilitary electronics

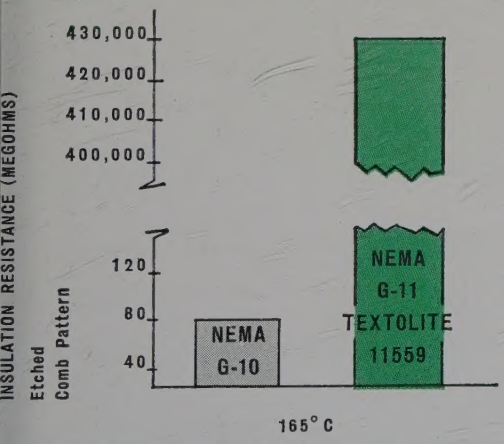
A BUILT-IN FIRE XTINGUISHER

Textolite® G-11 11559
elf-extinguishing laminate



Actual flame test of a non self-extinguishing glass-epoxy laminate and Textolite G-11 (11559) glass-epoxy laminate. Less than two seconds after removal of burners, flame on 11559 dies, the other glass-epoxy laminate continues to burn.

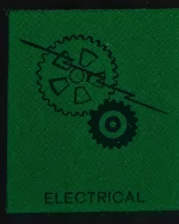
OUTSTANDING INSULATION RESISTANCE



Reduce fire hazard. This problem confronts many designers of computer and military electronic systems, especially where banks of circuit boards are required. Their solution . . . specification of G-11, self-extinguishing G-E TEXTOLITE 11559 glass-epoxy for printed circuits and structural electrical insulating material. Laboratory tests more severe than Standard ASTM flame tests prove Textolite 11559 flames-out within two seconds —never presents a fire hazard.

Easily exceeding requirements for NEMA G-11 laminates and specifications MIL-P-18177 Type GEB, transparent 11559 is available unclad or clad with 1 or 2 oz. copper on one or both sides. It surpasses other G-10 and G-11 laminates in its electrical properties at higher temperature ranges. Specifically, it provides low power factor, low dielectric constant and high insulation resistance into the 150° C range. Since it is highly resistant to solvents and etching solutions, rejects are considerably reduced.

For more information on 11559, consult Sweet's Product Design File, Cat 2b/Gen., or write: Laminated Products Department, Section I-21, General Electric Company, Coshocton, Ohio.

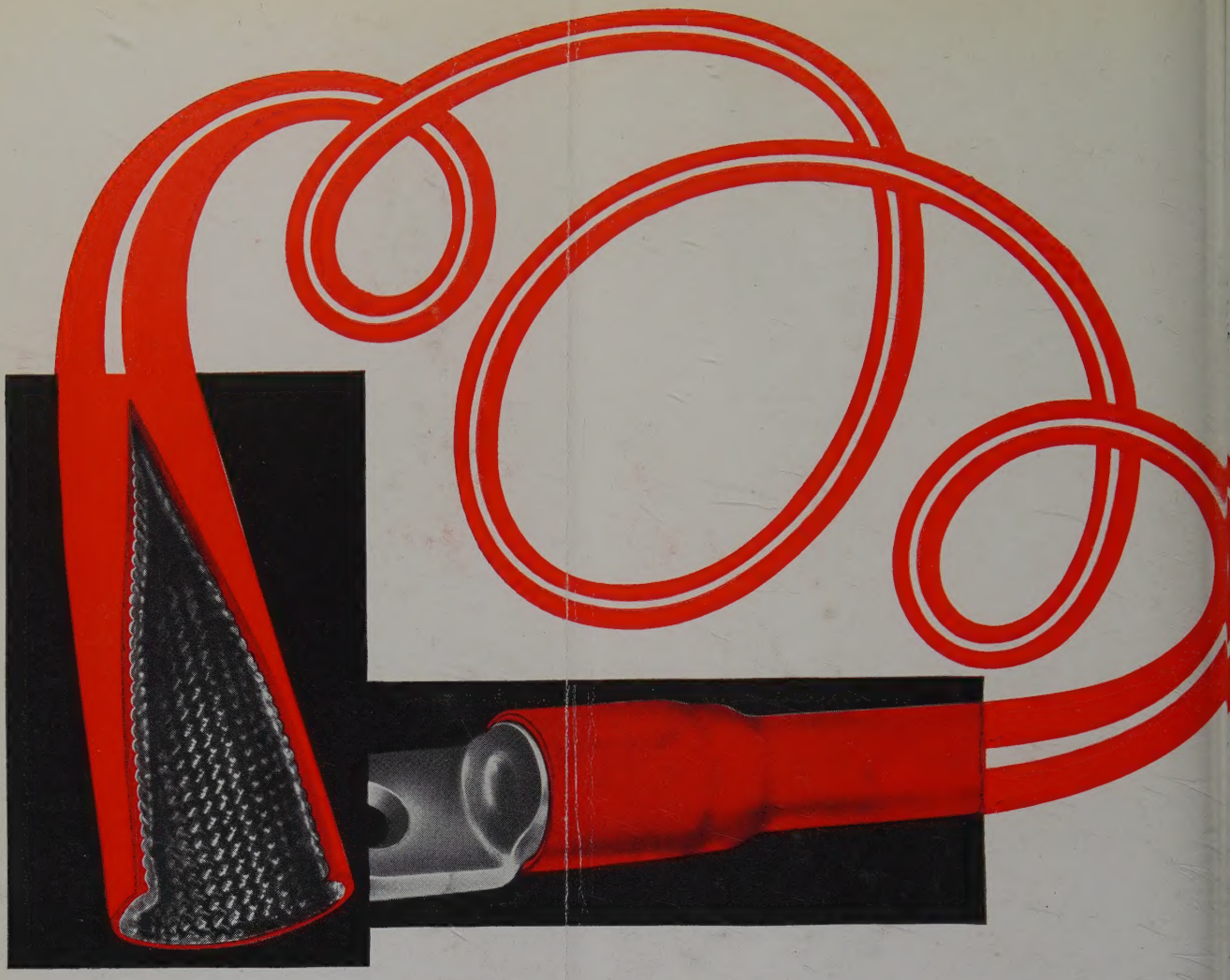


Progress Is Our Most Important Product

GENERAL ELECTRIC

COSHOCTON, OHIO

Print Ins. 57 on Reader Service Card



durasyl

means tougher more flexible class "H" Sleeving

The remarkable toughness, flexibility, heat life, and abrasion resistance of Bentley-Harris Class H sleevings are the result of an exclusive development — **durasyl.** This proprietary silicone rubber compound is extruded by a new (patent pending) technique to give you:

BEN-HAR "1151" durasyl Sleeving*

Fiberglass supported — most useful when physical toughness is the key design factor.

. . . Expands up to 400% increase in a.w.g. size without end fray. No breakdown from pushback, abrasion or rough handling. Snug fit over irregular knobs, terminals and connectors.

. . . Electronically inspected guaranteeing precisely controlled dimensions and 100% dielectric reliability.

*Now available in Grade H-C-1 and Grade H-A-1 in all sizes 24 through 2.

BEN-HAR "1258" durasyl Tubing

Most useful where maximum flexibility and efficient use of space are necessities.

. . . Offers self-fitting properties through dilation without affecting its superior dielectric and physical properties.

. . . 220°C. continuous operating temperatures. Permanent flexibility from −85°C. to 260°C.

. . . No breakdown in soldering operations.

. . . Highly resistant to abrasion, cut-through, mechanical stress. Over 1200 p.s.i. tensile strength.

Samples and data are available upon request

BENTLEY-HARRIS MANUFACTURING CO.
200 BARCLAY STREET **CONSHOHOCKEN 6, PA.**
Telephone: TAylor 8-7600 ***A SUBSIDIARY OF RAYCHEM***

Print Ins. 58 on Reader Service Card